Appendix L

Biological Assessment

MUKILTEO MULTIMODAL PROJECT

WASHINGTON STATE FERRIES (WSF) CAPITAL, REPAIR AND MAINTENANCE PROJECTS

REFERENCE BIOLOGICAL ASSESSMENT PROJECT FORM

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Acronyms and Abbreviations

ADA	Americans with Disabilities Act
Bgs	Below ground surface
BA	Biological Assessment
BAR	Biological Assessment Reference
BMP	Best Management Practice
dBA	decibel (A-weighted)
DMMP	Dredged Material Management Plan
DPS	Distinct population segment
DR	Discipline Report
EFH	Essential Fish Habitat
ESA	Endangered Species Act
ESU	Evolutionarily significant unit
ft	Feet
FTA	Federal Transit Administration
g	Grams
HOV	High occupancy vehicle
IHA	Incidental Harassment Authorization
m	Meters
MTCA	Model Toxics Control Act
NTU	Nephelometric turbidity unit
NMFS	National Marine Fisheries Service
OHL	Overhead loading
PAH	Polycyclic aromatic hydrocarbon
PCE	Primary constituent element
PGIS	Pollutant-generating impervious surface

PS	Puget Sound
RMS	Root mean square
Services	National Marine Fisheries Service and U.S. Fish and Wildlife Service
SR	State Route/Southern Resident
TDA	Threshold discharge area
USFWS	U.S. Fish and Wildlife Service
WDFW	Washington Department of Fish and Wildlife
WSF	Washington State Ferries

Date: October 24, 2012

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Project Title: Mukilteo Multimodal Project

Location(s) of Activity: Ferry Terminal: Mukilteo
Waterbody: Possession Sound
HUC Code: 171100190202 (Powder Mill Gulch-Frontal Possession Sound)

Summary of Effects Determinations

Species or Critical Habitat	ESA Listing Status[1]	Effect Determination[2]
Southern Resident DPS killer whale (*Orcinus orca*)	E	LAA
SR DPS killer whale critical habitat	D	LAA
Humpback whale (*Megaptera novaeangliae*)	E	LAA
Eastern DPS Steller sea lion (*Eumetopias jubatus*)	T	LAA
Marbled murrelet (*Brachyramphus marmoratus*)	T	NLAA
Puget Sound ESU Chinook salmon (*Oncorhynchus tshawytscha*)	T	LAA
Puget Sound ESU Chinook salmon critical habitat	D	LAA
Puget Sound DPS Steelhead (*O. mykiss*)	T	LAA
Coastal- Puget Sound DPS Bull trout (*Salvelinus confluentus*)	T	LAA
Coastal- Puget Sound Bull trout critical habitat	D	LAA
Georgia Basin/Puget Sound DPS bocaccio rockfish (*Sebastes paucispinis*)	E	NLAA
Georgia Basin/Puget Sound DPS canary rockfish (*Sebastes pinniger*)	T	NLAA
Georgia Basin/Puget Sound DPS yelloweye rockfish (*Sebastes ruberrimus*)	T	NLAA
Southern DPS eulachon (*Thaleichthys pacificus*)	T	NLAA
Southern DPS North American green sturgeon (*Acipenser medirostris*)	T	NLAA
Pacific groundfish, Coastal pelagic fish, & salmonid EFH	N/A	Will Adversely Affect

[1] E= endangered; T= Threatened; D= Designated

[2] LAA = May affect, likely to adversely affect; NLAA = May affect, not likely to adversely affect

1. Project Description

The Washington State Department of Transportation, Ferries Division (WSDOT/WSF) and the Federal Transit Administration (FTA) are proposing the Mukilteo Multimodal Project to improve the operations and facilities serving the mainland terminus of the Mukilteo-Clinton ferry route in Washington State. The ferry route is part of State Route (SR) 525, the major transportation corridor crossing Possession Sound, the portion of Puget Sound that separates Island County (Whidbey Island) from the central Puget Sound mainland. In 2011 the Mukilteo-Clinton route was WSF's busiest route for vehicle traffic and had the third highest total annual ridership, serving almost four million total riders.

The purpose of the Mukilteo Multimodal Project is to provide safe, reliable, and effective service and connection for general purpose transportation, transit, high occupancy vehicles (HOV), pedestrians, and bicyclists traveling between Island County and the Seattle/Everett metropolitan area and beyond. The Mukilteo ferry terminal has not had significant improvements for almost 30 years and needs key repairs. The existing facility is deficient in a number of aspects, such as safety, multimodal connectivity, capacity, and the ability to support the goals of local and regional long range transportation and comprehensive plans. The project is intended to:

- Reduce conflicts, congestion, and safety concerns for pedestrians, bicyclists, and motorists by improving local traffic and safety at the terminal and the surrounding area that serves these transportation needs.
- Provide a terminal and supporting facilities with the infrastructure and operating characteristics needed to improve the safety, security, quality, reliability, efficiency, and effectiveness of multimodal transportation.
- Accommodate future demand projected for transit, HOV, pedestrian, bicycle, and general purpose traffic.

The project is located within the range of species protected under the federal Endangered Species Act (ESA) of 1973, as amended. Because the project will receive funding from FTA, interagency consultation with the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) (together, the Services) is required pursuant to Section 7(a)(2) of the ESA. WSF has prepared this biological assessment (BA) on behalf of FTA, as required under Section 7(c) of the ESA, to facilitate interagency consultation and address potential project impacts on species listed or proposed for listing under the ESA. The alternative under consultation is WSF's preferred alternative.

Project Location

The Mukilteo Ferry Terminal is located in the City of Mukilteo, Snohomish County, Washington. The terminal is located in Township 28 North, Range 4 East, Section 3, in Possession Sound. The new terminal would be approximately 1,700 feet (ft) east of the existing terminal in Township 28N, Range 4E, Section 33 (Figure 1).

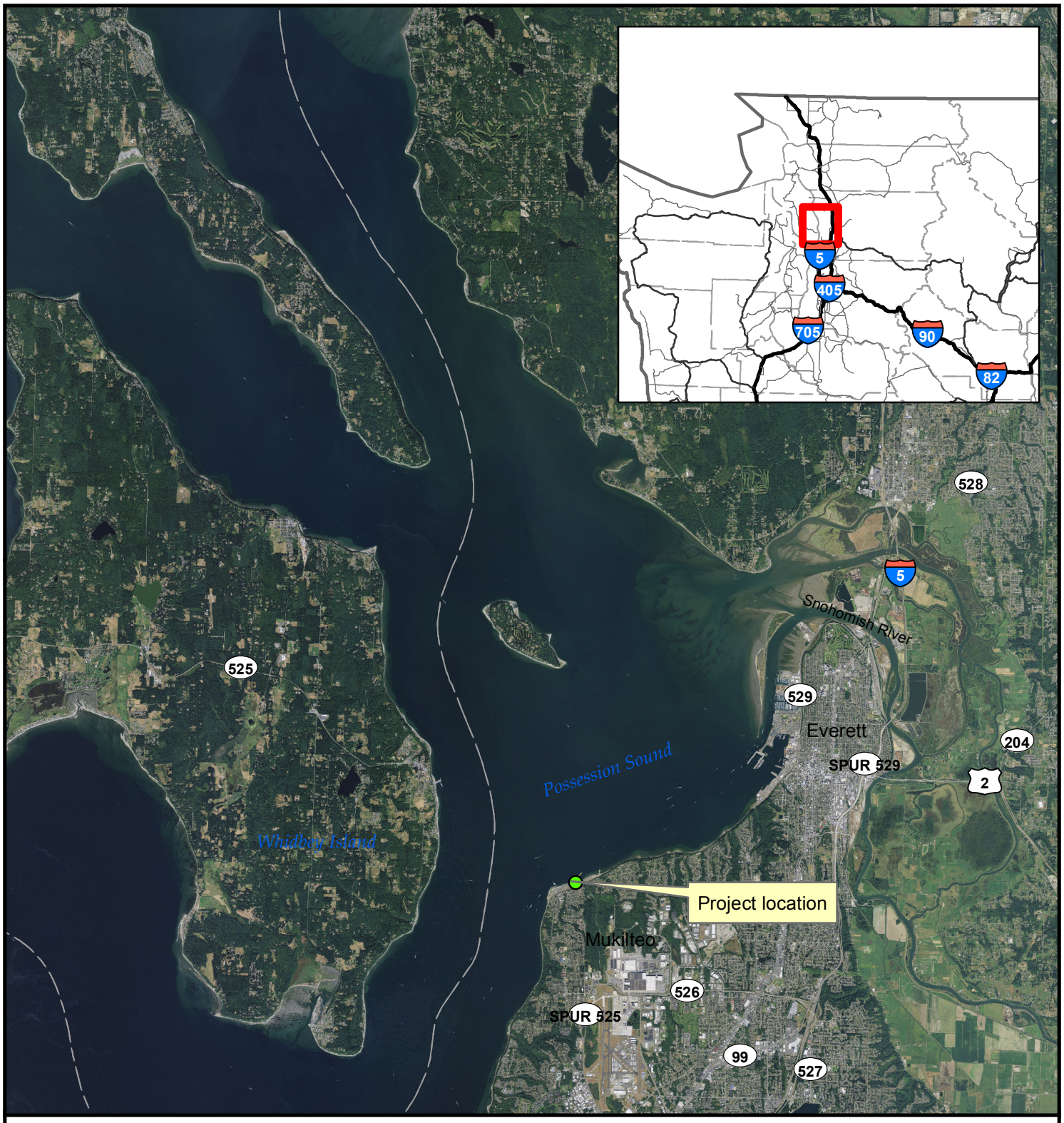

Figure 1. Mukilteo Multimodal Project vicinity map

0 0.5 1 2 Miles

N

Washington State Department of Transportation

Project Elements

The project will move the ferry terminal east of its existing location in downtown Mukilteo to the former U.S. Department of Defense Fuel Supply Point facility, known as the Tank Farm property, which includes a large pier extending into Possession Sound (the Tank Farm pier). A new roadway will connect from SR525 east to the Mukilteo Commuter Rail station and continue on to the ferry terminal and associated transit center and Mt. Baker Crossing (Figure 2). The project involves both marine and land components as described below. Some typical or likely minimization measures are described in the following discussion, particularly when the measure is integral to the construction activity, but please note that a subsequent section details all of the potential minimization measures (listed by type of activity). Additional detail on project components, construction methods, and minimization methods can be found in the WSF BA Reference (BAR) as cited in the text.

Marine Components

The project will construct a new concrete trestle and bulkhead, as well as a transfer span with lifting mechanisms and structures. A pedestrian overhead loading structure will be built just west of the trestle. Wingwalls will be constructed on either side of the trestle, and fixed dolphins located on either side of the slip. A floating dolphin will be relocated from the existing ferry terminal. The Tank Farm pier will be removed and a navigation channel approximately 500 ft wide dredged through the sediment mound underneath the pier. The existing terminal will be removed and the Port of Everett's fishing pier and day moorage will be relocated just west of the proposed terminal (Figure 2).

Tank Farm Pier Removal

The Tank Farm pier will be removed as part of this project. The pier, which has not been used for fuel transfers since the late 1970s, covers approximately 138,080 ft^2 (3.17 acres) over water and contains approximately 3,900 creosote-treated piles. Demolition of the pier will remove approximately 7,300 tons of creosote-treated timber from the aquatic environment. Demolition will take approximately ten months over two in-water work windows (Table 1). Removal of the pier will occur from land and from a barge containing the necessary equipment.

Piles will be removed with a vibratory hammer to the extent possible. This method minimizes the amount of turbidity generated during pile removal. The crane operator will take measures to reduce turbidity, such as vibrating the pile slightly to break the bond between the pile and surrounding soil, and removing the pile slowly. If piles are so deteriorated they cannot be removed using vibratory methods, the operator will use a clamshell to pull the piles from below the mudline, or cut at or just below the mudline using a hydraulic saw.

The priority will be to completely remove the piling in its entirety before cutting; however, cutting will be necessary if the pile has broken off at or near the existing substrate so that it

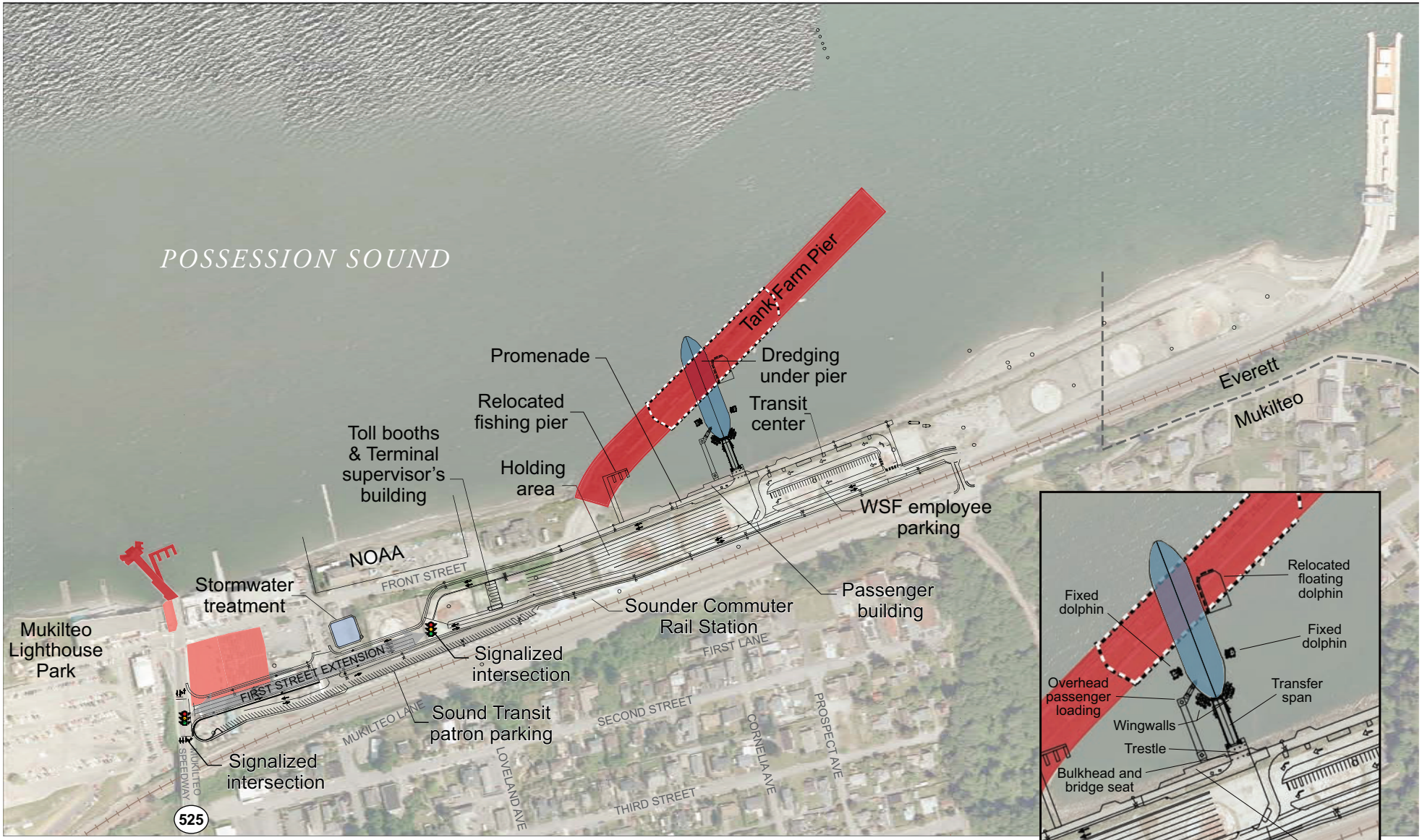

Figure 2. Project elements.

Table 1. Project components and approximate durations

Project element			2015						2016												2017									
			Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Demolish Tank Farm pier																														
Construct new terminal	Site demolition																													
	Site construction	Earthwork																												
		Utilities																												
		Surfacing																												
		Striping/lighting																												
Dredging																														
Construct trestle and bulkhead																														
Stone columns																														
Pedestrian OHL foundation																														
Pedestrian OHL structure																														
Passenger building																														
Transfer span																														
Wingwalls																														
Inner fixed dolphins																														
Demolish existing terminal pier																														
Relocate floating dolphin																														
Demolish existing terminal																														
Establish First St/SR525 connection																														

cannot be removed without excavation. Prior to commencement of the work the contractor will assess the condition of the pilings. The contractor will create a log outlining the location and number of pilings that need to be cut and have this log available to the agencies upon request. The contractor will provide the location of broken piles using GPS. This will be necessary as part of debris characterization should future dredging be a possibility in the area of piling removal

In cases where piles break during removal or their condition has deteriorated to the point where removing an intact pile is not possible, pile removal will be guided by the following:

- A chain will be used, if practical, to entirely remove the broken pile.
- If the entire pile cannot be removed, the pile will be cut at or below the mudline using a pneumatic underwater chainsaw. Project-specific requirements for cutoff will be set by the project engineer considering the mudline elevation and the presence of contaminants in the sediment according to the following guidelines:
    - If sediments are contaminated and the mudline is subtidal, piling will be cut off at the mudline to minimize disturbance of the sediment.
    - Piling will be cut off at least one foot below the mudline in intertidal areas where the work can be accomplished in the dry.
    - Piling will be cut off at least one foot below the mudline in subtidal areas where the sediments are not contaminated. Repeated attempts at pile removal using a clamshell bucket (i.e., "grubbing") will not occur in contaminated sediments, or below the water line.
    - In the absence of information to the contrary, the contractor will assume sediments in the project area are contaminated and implement appropriate construction methods and Best Management Practices (BMPs) as described in detail in the "Minimization Measures" section, below.
- Piles will be cut off at lowest practical tide condition and at slack water. This is intended to reduce turbidity due to reduced flow and the shorter water column through which the pile must be withdrawn.
- If the piling is broken off one foot or more below the mudline, the piling may remain, provided it is located in deep subtidal waters. In intertidal and shallow subtidal areas, seasonal raising and lowering of the beach could expose the pilings above the mudline and leach out creosote or other contaminants. In these waters, the piling will be cut off at least two feet below the mudline.

Any piles within the dredge channel will be removed completely. BMPs will be employed during pier removal to minimize turbidity and prevent the spread of any creosote-treated pier fragments. BMPs specific to pile removal include filling holes left by removed piles with clean material to restore the substrate surface, using containment booms to prevent the spread of any oil or wood scraps, and water quality and turbidity monitoring (see Minimization Measures, below).

Pile removal for the Tank Farm pier will be sequenced to minimize impacts to the nearshore during the early part of the in-water work window when listed salmonids could still be present. Pile removal will begin at the seaward side of the pier, which is approximately 600 ft offshore, and gradually move inland as work progresses.

Dredging (WSF BAR Section 2.1.2)

The project will dredge an area approximately 500 ft long x 100 ft wide to a depth of up to -30 MLLW (about 19,500 cubic yards [cy]) to provide a navigation channel through the sediment mound underneath the Tank Farm pier. The landward edge of the dredge prism is approximately 230 feet offshore, and extends northeast to about 410 feet offshore (Figure 2). Dredging will last less than a month, and is currently scheduled for December 2015/January 2016, during the portion of the in-water work window when listed salmonids are least likely to be present in the action area (Table 1). Several BMPs will be deployed during dredging to limit turbidity, such as removal of piles from the dredge prism prior to dredging (to ensure smooth operation of the bucket), controlling the bucket speed, and turbidity and water quality monitoring. A full list of BMPs is provided in the Minimization Measures section, below, as well as the WSF BAR.

Spoils will generally be disposed of offshore in compliance with Dredge Material Management Program (DMMP) standards. However, initial testing of sediments indicates that some areas contain levels of contamination above DMMP standards. Additional sampling will occur prior to construction to more accurately characterize the level and extent of contamination. Any dredged material that exceeds DMMP criteria will be removed and disposed of at existing upland commercial facilities permitted to accept contaminated waste. Transport of contaminated material will use existing haul routes, such as state highways. The contractor will provide bills of lading to WSDOT to ensure that contaminated materials have been disposed of properly.

The post-dredge surface will be sampled to determine whether a containment cap is necessary. If the samples indicate that the post-dredge surface is contaminated, the area will be over-dredged by two feet to accommodate the placement of a cap of appropriately-sized clean material.

Stone Columns

Stone columns will be placed underneath the trestle, transfer span, and overhead loading structure over an area of approximately 25,000 ft^2 (Figure 3). Stone columns are a ground improvement technique consisting of installing aggregate columns in the subsurface to reinforce, densify, and provide drainage of potentially liquefiable soils. The columns are constructed using a down-hole vibratory probe. The probe penetrates to the design depth by means of the probe's weight and the vibrations. Stones (such as crushed gravel) are fed into the soil at the vibrator tip through a feed pipe attached to the vibrator. Compressed air or water is used to push the gravel through the feeder tube and into the subsurface. The

Perimeter Sediment Samples

Year	Sample ID	Depth	Contaminant of Concern
1986	NG-07	Surface	Acenapthene
	NG-09		Benzoic acid
2003	SS01-SS13	Surface	No exceedances
	IS01-IS-10	Surface	
2012	V1/V6	0-4' composite	Chlordanes
	V2/V5		
	V3/V4		
	V1/V6	4-8' composite	No exceedances
	V3/V4		Chlordanes
	V4	8-12' (discrete)	++
2012	D1	0-4' (discrete)	No exceedances
	D2		
	D3		
	D2	4-8' (discrete)	Archived; not analyzed
	D3		

AREA 1* AREA 3* AREA 3* AREA 2*

FORMER FUEL PIER

APPROXIMATE AREA OF STONE COLUMN INSTALLATION

OUTFALL

OIL/WATER SEPARATORS

BNSF RAILWAY CORRIDOR

BURLINGTON NORTHERN & SANTA FE RAILWAY (FORMERLY GNRY)

SCALE: 1"=80'

Soil Samples

- Surface impacted soil: COCs = petroleum hydrocarbons, PAHs; confirmed 2007
- 8-12' bgs impacted soil: COCs = petroleum hydrocarbons, BTEX, PAHs; confirmed 2007
- Suspected, impacted surface soil (petroleum hydrocarbons, pesticides, metals, PAHs)
- Suspected, impacted soil 8-12' bgs (petroleum hydrocarbons, BTEX and/or PAHs)
- Mukilteo multimodal project boundary

2006/2007ARCHAEOLOGICAL/GEOTECHNICAL INVESTIGATION LOCATIONS

- 72 > MTCA (boring)
- BT15 > MTCA (trench)
- 67 >200 ppm PID (boring)
- BT11 >200 ppm PID (trench)
- 13 Observation of impacted soils
- 65 <200 ppm PID (boring)
- BT14 <200 ppm PID (trench)
- 25 Boring locations (8/06; 9/06; 4/07), no impacts observed
- BT3 Approximate NWAA trench locations (7/06) no impacts observed

*Areas as identified in the "Mukilteo Multimodal Project Draft Environmental Impact Statement Hazardous Materials Discipline Report" January 2012

MARK	REVISION DESCRIPTION	BY	APP.	DATE

BergerABAM
33301 9th Avenue South, Suite 300
Federal Way, Washington 98003-2600
(206) 431-2300 Fax: (206) 431-2250

Washington State Department of Transportation
WASHINGTON STATE FERRIES

DRAWN BY	CDR
DESIGN BY	
CHECK BY	SLF
PROJ MGR	SLF

MUKILTEO MULTIMODAL PROJECT SITE: ASSESSMENT

Figure 3. Area of stone column installation and contaminants of concern

DRAWING NO.	5
PROJECT NO.	FAWAT-07-859
DATE:	09/27/2012
SHEET NO.	5 OF 5

Last Saved by: Ryan.weston on: Sep 28, 2012 12:46 PM File: Q:\FederalWay\2007\FAWAT-07-859\NaturalResources\Graphics\Environmental Assessment\Fig5_Stone Column 092712.dwg

gravel creates a stiff column that reinforces the treatment zone and densifies the surrounding soils.

For this project, approximately 200 three-ft diameter columns will be installed in a grid pattern, with row spacing ranging from five to 10 feet. Columns will extend 60 ft below ground surface. Column material will be gravel that meets WSDOT Standard Spec 9-03.9(2) (http://www.wsdot.wa.gov/Publications/Manuals/M41-10.htm). Approximately 3,142 cubic yards of material will be used for stone column construction. Construction of the columns will take approximately four weeks. The area of stone column installation has been located to avoid contaminants of concern in the project area (Figure 3).

Photographs of the vibratory equipment and placement of gravel into the soil are provided below.

Trestle and Bulkhead (WSF BAR Section 2.1 p. 60)

A new concrete trestle measuring 1,600 ft² will be constructed as shown in Figure 2. The new trestle will be supported by 14 24-inch diameter octagonal concrete piles that will be installed using an impact hammer. It will take as long as two hours to drive each pile over the course of five days.

During construction, a floating barge measuring 50 x 150 ft (7500 ft²) will be anchored adjacent to the new terminal to support cranes, pile driver, and other construction equipment. The barge will be anchored with two 2 x 2 ft spuds for the duration of construction (one in-water work season). The barge will be moved periodically to access different work areas.

Transfer Span (WSF BAR Section 2.2.4, p. 55)

The new transfer span will measure approximately 2,600 ft² and will be supported by two 60-inch diameter drilled shafts. Steel casings for the drilled shafts will be installed using a vibratory hammer. After the casing is installed, the interior of the casing will be augered out to below the level of the casing. A rebar cage will be placed inside the casing and concrete will then be cast into the augered hole. It will take approximately one hour to drive each casing based on known soil conditions. Casing installation could take longer if an obstruction is encountered. Installing the casings would likely occur over two days. Total construction duration for the drilled shafts will be about two weeks.

Directional lighting for operation of the facility will be installed on the trestle and transfer span. Light will be directed onto the structures themselves and not into the water, to minimize light spillage from these structures. Shielding will also minimize light spillage.

Overhead Loading Structure (WSF BAR Section 2.2.7, p. 65)

An overhead loading structure measuring 2,600 ft² will be constructed on the west side of the trestle and will be supported by one 131-inch diameter drilled shaft (Figure 2). As with the transfer span, the shaft casing will be vibrated into place. Installation of the casing will take about an hour, depending on soil conditions. Construction of the drilled shaft will last about two weeks.

Wingwalls and Fixed Dolphins (WSF BAR Section 2.2.2, p. 48)

Wingwalls encompassing approximately 900 ft² will be constructed on either side of the seaward end of the transfer span. Nine 18-inch steel piles will be used to support each of the two wingwalls, for a total of 18 piles. Fixed dolphins will be constructed just beyond the wingwalls using 18 30-inch steel piles installed with a vibratory hammer. Because the dolphins and wingwalls are not load-bearing structures they will not need to be proofed with an impact hammer. It will take approximately 30 minutes to install each pile; pile installation will last about six days.

Floating Dolphin (WSF BAR Section 2.2.1, p. 37)

A floating dolphin measuring 85 x54 ft (4,600 ft²) is anchored at the existing terminal. The dolphin will be relocated from the existing terminal and anchored adjacent to the new terminal.

Existing Terminal Removal

The existing terminal will be removed once the new terminal is complete. The existing terminal comprises 8,120 ft^2 of overwater cover and contains 248 creosote-treated piles. Demolition of the terminal will remove approximately 406 tons of creosote-treated timber from the aquatic environment. Demolition will take approximately two weeks and will occur from land and from a barge containing the necessary equipment.

As with the Tank Farm pier, piles may be removed with a vibratory hammer, a clamshell, or pulled directly (WSF BAR 2.1.1.1, p. 11). BMPs will be employed during pier and terminal removal to minimize turbidity and prevent the spread of any creosote-treated pier fragments (see Minimization Measures, below).

New Terminal Building

The new terminal building will be constructed along the shoreline west of the trestle. The building will extend slightly over the water, creating approximately 2,464 sf of overwater cover. The waterward extent of the building will be supported by eight 24-inch concrete piles installed below the ordinary high water mark. Piles will be installed with an impact hammer.

Fishing Pier Relocation

The Port of Everett public fishing pier/seasonal day moorage is situated just east of the existing terminal and shares part of its foundation with the existing terminal. The pier measures over 2,000 ft^2 and contains 42 12-inch diameter creosote-treated timber piles. The pier will be removed when the existing terminal is demolished; removal of both structures will take about two weeks. The existing terminal and fishing pier will be removed using both land and barge-based equipment.

A replacement fishing pier will be built just west of the new terminal and cover approximately 3,178 ft^2. The pier will be supported by 12 24-inch diameter concrete piles that will be installed using an impact hammer. About 15 12-inch diameter steel piles will also be installed for fenders and guide piles. The steel piles will be vibrated into place. Because they are not load-bearing structures they will not need to be proofed with an impact hammer.

Surface samples collected in 2003 from the proposed fishing pier location had no exceedences of Washington State Sediment Management Standards.

Land Components

First Street will be realigned and extended as a four-lane roadway from a new intersection with SR525 to the new ferry terminal and continue to a new bus transit facility. A new public parking area will be situated between the BNSF railroad and First Street. The extended roadway will provide sidewalks and bike lanes.

The vehicle holding area will be situated on the western portion of the site. Toll booths will be located west of the holding area, and the terminal supervisor's building placed above the toll booths. A new two-story passenger and maintenance building will be aligned parallel to the shoreline and will span the vehicle driveway to the ferry trestle. An overhead loading ramp will connect to the second story of the building (Figure 2).

The two-story passenger and maintenance building will provide a continuous waterfront promenade connection, and an alternate pathway connecting the waterfront promenade will go around the site. New overhead lighting will illuminate First Street and the terminal facilities. The upland elements of the existing ferry terminal (such as the waiting area, restroom, and terminal supervisor building) on the Mukilteo waterfront will be removed. The portions of the vehicle holding area and WSF employee parking areas near the current terminal that are not covered by the new First Avenue will be vacated.

The Tank Farm property sits on top of a prehistoric archaeological site containing an undisturbed shell midden. Petroleum hydrocarbons and other contaminants of concern have been encountered in soils on the property. Groundwater may also contain contaminants of concern. The land components of the project have been arranged to avoid excavation within the shell midden, as well as areas of known contamination (see discussion of upland contamination in Effects Analysis section, below). The project will use between one and seven feet of fill (depending on the location) to prevent impacts to the midden and minimize contact with any known contaminated areas. The fill will slope gradually downward to meet the grade of adjacent properties. Appendix A contains plan sheets detailing the grading plan and stormwater facilities. To further minimize impacts, excavation for deep utilities has been placed along 1st Ave, and structure foundations will be on piles.

Additional testing will take place prior to construction to characterize the type and extent of contamination in areas that will be disturbed. Any contaminated soils encountered during construction will be removed and disposed of at existing upland facilities permitted to accept contaminated waste. Transport of contaminated material will use existing haul routes, such as state highways. The contractor will provide bills of lading to WSDOT to ensure that contaminated materials have been disposed of properly.

Stormwater Treatment

The project will create approximately 10.2acres of new pollution-generating impervious surface (PGIS); no PGIS will be removed. Stormwater from the new terminal will be discharged via three outfalls: an existing outfall west of Brewery Creek, an existing 30-inch diameter outfall, and a new outfall that will be constructed on the eastern edge of the site.

Stormwater from the existing terminal vicinity currently discharges untreated to Possession Sound. Runoff from the proposed project will receive enhanced treatment. Stormwater will be captured by shrub/tree vault treatment catch-basins with piping from the catch-basins to

either outfalls or to bioretention areas. Slope for depth of piping will be minimized in order to avoid deep trench excavations. Doing so will avoid or minimize conflicts with groundwater, the shell midden, soil contaminants. The west end of the site will be routed to the existing 24-inch pipe outfall. The center of the site will be routed to an existing 30-inch outfall. Water from the eastern portion of the site will be routed to a new outfall.

The project will provide enhanced stormwater treatment for all new PGIS. Treatment will be provided by Filterra cartridges installed underneath the holding area (http://www.filterra.com/index.php/product/) or by natural bio-retention systems. Infiltration (permeable pavement) is being investigated as a means of stormwater treatment for the east end of the site. Preliminary soil testing has occurred to determine the extent of contamination on the site. Field testing in final design will be performed on any areas proposed for infiltration to confirm areas suitable for infiltration (where the surface water can be infiltrated without it combining with contaminated soil or groundwater). If field testing shows that soils or groundwater are contaminated beyond acceptable limits, infiltration will not be used, and water will be discharged via the new outfall.

Site-specific cleanup levels already established for the property will be used to determine acceptable levels for groundwater and soil contamination (see Tables 2 and 3 of the Hazardous Materials Discipline Report [DR] prepared for the project for a list of contaminants with site-specific cleanup levels). The DR can be found online at http://www.wsdot.wa.gov/Projects/Ferries/mukilteoterminal/multimodal/library.htm). Results for other contaminants of concern will be compared to MTCA Method A Cleanup Levels for Unrestricted Land Use.

The stormwater analysis in this BA conservatively assumes no infiltration. If infiltration is selected as a means of stormwater treatment, actual pollutant loads will be less than what is presented here. WSF will notify the Services if final design of stormwater treatment methods differs from what is discussed in this document.

WSF currently sweeps the Mukilteo terminal and holding lanes on a quarterly basis using a high-efficiency vacuum sweeper. The new terminal will also be swept every three months or more as needed.

Project Schedule

Project construction is scheduled to begin in 2015 and last for approximately two years. In-water work will occur during the approved in-water work window for the project, which WSF expects to be generally July 15- February 15. The project will take place over two in-water work seasons. Approximate durations of the various project elements are listed in Table 1.

Minimization Methods

For WSF's Construction Minimization Measures, see WSF BAR Section 2.3 (pp. 73-80). Additional BMPs that will be incorporated into the project include:

BMPs specific to pile removal:

- Vibratory extraction is the preferred method of pile removal.
- The crane operator will be trained to remove piles slowly to minimize turbidity in the water as well as sediment disturbance.
- The operator will "wake up "the pile to break the bond with surrounding sediment by vibrating the pile slightly prior to removal. Waking up the pile avoids pulling out large blocks of sediment, which could cause the pile to break apart during the removal process, and usually results in little to no sediment attached to the pile during withdrawal.
- Extraction equipment will be kept out of the water, above the water line, to prevent creosote release into the water that could occur if the pile is pinched by extraction equipment below the water line.
- Piling will not be broken off intentionally by twisting, bending, or other deformation, to minimize any potential release of creosote into the water column.
- The work surface on the barge deck or pier will include a containment basin for pile and any sediment removed during pulling. The basin will be constructed of durable plastic sheeting with sidewalls supported by hay bales or a support structure to contain all sediment. The containment basin shall be removed and disposed of in accordance with applicable federal and state regulations.
- The work surface shall be cleaned by properly disposing of sediment or other residues along with cut-off piling.
- Upon removal from the substrate the pile shall be moved expeditiously from the water into the containment basin. The pile shall not be shaken, hosed-off, stripped or scraped off, left hanging to drip or any other action intended to clean or remove adhering material from the pile.
- Prior to commencement of the work the project engineer or contractor will assess the condition of the pilings. Contractor or project engineers will create a log outlining the location and number of pilings that need to be cut and have this log available to the agencies upon request.
- Holes left when removing piling will be filled with clean sand or gravel. Sand or gravel used as fill material will be obtained from a commercial source that is free of contaminants.
- During removal of creosote-treated piles, containment booms and absorbent booms (or other oil-absorbent fabric) will be placed around the perimeter of the work area to capture wood debris, oil, and other materials if released into marine waters. All accumulated debris will be collected daily and disposed of at an approved upland site.

- Removed creosote-treated piles will be disposed of in a manner that precludes their further use. Piles will be cut into manageable lengths (four feet or less) for transport and disposal in an approved upland location that meets the liner and leachate standards contained in the Washington Administrative Code (WAC), Chapter 173-304, Minimum Functional Standards. No reuse of treated wood will occur.
- Water quality will be monitored every four hours during pile removal. Treated wood will be contained during and after removal to preclude sediments and contaminated materials from entering the aquatic environment.
- Hydraulic water jets will not be used to remove piles.
- Work barges and dredged material disposal barges will not be allowed to ground out or rest on the substrate, or be over or within 25 ft of vegetated shallows (except where such vegetation is limited to state-designated noxious weeds).
- Barges will not be anchored over vegetated shallows for more than 24 hours.

BMPs specific to dredging:

- Existing creosote-treated timber piles will be fully extracted from the dredge prism prior to beginning any dredging operations.
- The dredging rate will be reduced (this is especially important with respect to bucket speed approaching the sediment surface and bucket removal from the surface after closing).
- The dredge bucket will not over-penetrate surface sediments, which can cause sediment to be expelled from the vents in the bucket or cause sediment to become piled on top of the bucket, and then eroded during bucket retrieval.
- The method of operating the dredge will be modified based on changing site conditions such as tides, waves, currents, and wind.
- The depth of the cutterhead, rate of swing of the ladder and of the rotating cutterhead, and the dredge's speed of advance will all be modified to minimize turbidity.
- Aprons will be employed to catch spillage and a rinse tank will be used to clean the bucket each cycle.
- The number of dredging passes (vertical cuts) will be varied to increase sediment capture.
- Properly sized tugs and support equipment will be used.
- Overflow from barges during dredging or transport will not be permitted.
- Temporary barriers such as silt curtains may also be installed though their efficacy will be strongly influenced by wind, current and wave conditions at the site.
- Oil booms will be readily available for containment should any creosote releases occur Multiple bites while the bucket is on the bottom will not be permitted.
- Dredged material aboard the barge will be observed daily for the presence of fish to ensure that they are not being impinged by the clamshell bucket. If impingement occurs, crane operation will be slowed to increase opportunity for fish to avoid the bucket.

- The barge will be managed such that the dredged sediment load does not exceed the capacity of the barge. The load will be placed in the barge to maintain an even keel and avoid listing.
- Dredge vessel personnel will be trained in hazardous material handling and spill response and will be equipped with all necessary response tools, including absorbent oil booms. In the event of a spill, spill cleanup and containment efforts will begin immediately and will take precedence over normal work.
- The dredging contractor will regularly inspect fuel hoses and oil or fuel transfer valves and fittings on the dredging equipment for drips or leaks in order to prevent spills into the surface water. Spill containment booms and absorbent materials will be kept on the dredge barge at all times during dredging operations.
- Surface sediment sampling will take place post-dredging. Any contamination will either be removed by over-dredging or capped with a layer of clean coarse material.

BMPs specific to stone column installation

- Stone column fill material will not be permitted outside the filling area.
- Water quality will be monitored during stone column installation.
- If water quality monitoring indicates an exceedance of threshold values, the outflow velocity of the water/air jet will be decreased.
- Barriers such as silt curtains or upland erosion barriers will be installed as feasible given site conditions to prevent potential increases in turbidity or releases from migrating.

Water quality monitoring for all in-water work

- Turbidity and other water quality parameters will be monitored to ensure construction activities are in compliance with Washington State Surface Water Quality Standards (173-201A WAC), or other conditions as specified in the WQC and the project permits.
- Turbidity sampling and documentation shall occur at a minimum of 150 ft and 300 ft from in-water construction activities.
- Turbidity will not exceed 5 NTU over background turbidity when the background is 50 NTU or less, or more than a ten percent increase in turbidity when the background turbidity is more than 50 NTU, at the point of compliance.
- If exceedances of turbidity standards are detected at the point of compliance, work will stop immediately. The contractor will assess the cause of the water quality problem and take immediate action to stop, contain, and correct the problem. The contractor will then assess the efficacy of the site BMPs and update or improve the BMPs to prevent a recurrence of the exceedance. The Washington State Department of Ecology will be notified within 24 hours in the event of an exceedance.

BMPs to Minimize Upland Contamination

- The project has been designed to avoid areas of known contamination to the extent possible.
- Areas where excavation will take place will be tested prior to ground-disturbing activities. Contaminated soils will be disposed of at appropriate upland locations.
- Fill will be used extensively within the project boundary to cap contaminated soils.
- Stormwater facilities will not be sited in areas known to be contaminated, or will be completely contained to prevent contact of stormwater with contaminated soils or groundwater. Most stormwater facilities will be constructed within areas of clean fill.
- Groundwater in excavation and infiltration areas will be characterized prior to the start of construction.
- The analytical results from groundwater samples will be used to identify areas where dewatering water needs to be collected in portable water storage tanks, sampled, and disposed of at an appropriate disposal facility. There are three options for disposal of groundwater removed from excavations:
    - Storm drain disposal for groundwater that is not contaminated
    - Sanitary sewer disposal under NPDES permit
    - Transport to an offsite facility that is suitable for the disposal of contaminated groundwater.
- Groundwater conditions will be evaluated for odor, sheen, or any other indications that hazardous materials are present in or impacting groundwater encountered in excavations.
- All work will be conducted by workers trained in hazardous materials handling and in the proper use of personal protection equipment and decontamination procedures.

The project will obtain an Incidental Harassment Authorization (IHA) through the Marine Mammal Protection Act prior to project construction. Marine mammal monitoring and other conditions of the IHA will be implemented during impact pile driving

Marbled murrelet monitoring will be implemented during impact pile driving. Pile driving will not be initiated, or if initiated will be ceased, if marbled murrelet are present within the injury zones. Additional detail is presented in the Effects Analysis sections on marbled murrelets and in Appendix B (Marbled Murrelet Monitoring Plan).

Consultation History

A NMFS liaison attended a natural resources meeting for the Draft Environmental Impact Statement on February 15, 2012. WSF and FTA provided a draft of the first section of the BA (project description, action area, environmental baseline, and species presence in the action area) for review and comment to liaisons from NMFS and USFWS on July 16th, 2012. Liaisons from both Services attended a natural resources meeting on July 19, 2012, where

WSF presented results of hydrodynamic modeling and sediment analysis. The project biologist met with the NMFS liaison on August 22, 2012, to discuss proposed stormwater treatment; the same information was provided to the USFWS liaison via e-mail on August 30, 2012.

A draft of the entire document was forwarded to the liaisons on September 13, 2012. Project staff met with the liaisons on September 24, 2012 to address additional information needs requested by the liaisons. USFWS provided additional comments on the draft BA on September 26, 2012. Representatives from both Services attended a natural resources meeting on October 18, 2012 to discuss construction impacts, minimization measures, and BMPs.

2. Action Area

The action area is defined as the geographical extent of project impacts and not merely the immediate project vicinity. The action area includes the project footprint and all surrounding areas where project activities could potentially affect the environment. The extent of the action area encompasses direct and indirect effects as well as any effects of interrelated and interdependent actions.

The greatest extent of impacts from this project results from noise generated by impact pile driving. Such noise driving will travel differently over land and over water, as described below.

In-air Noise Propagation

Noise attenuates as the distance from the source of the noise increases. A general equation shows noise propagation loss in air as 6 decibels (dB) for each doubling distance in areas of hard ground cover, such as streets, sidewalks, and over water (hard sites). In areas where landscape features and vegetation exist (soft sites), noise attenuates at 7.5 dB per doubling distance from the source (WSDOT 2012). Ferry terminals are generally considered hard sites due to surrounding development and the presence of water; however, the presence of nearby vegetation and the bluff on the landward side of the proposed terminal make the proposed terminal location a soft site on the landward side, and a hard site on the waterward side.

The existing terminal is in downtown Mukilteo and the proposed terminal is east of the existing terminal. Except for Japanese Gulch, the existing and proposed terminal locations are surrounded by developed areas with moderate levels of traffic. Ambient noise levels near the existing terminal were measured at 64.0 dBA; noise closer to the proposed terminal location was measured at 71.6 dBA (Jacobs Civil Inc 2006). This analysis used the more conservative 64.0 dBA level.

The project construction activity that will generate the highest noise level is impact pile driving of concrete piles for the trestle, which is expected to produce an estimated peak sound pressure of approximately 110 dBA measured 50 ft away from the source (WSDOT 2012). Using the in-air noise attenuation model of 6.0 dB per doubling distance for a hard site, the 110 dBA produced during impact pile driving will attenuate to the ambient noise level of 64 dBA at approximately 10,000 ft over water. At a 7.5 dB reduction per doubling distance for a soft site, impact pile driving noise will extend 3,500 ft over land.

Aquatic Considerations

Pile Driving

Vibratory pile driving is usually measured as the root mean square (RMS) pressure level during the sound impulse. RMS levels are also used to describe disturbance level effects to

marine mammals and behavioral disturbance effects to fish and marbled murrelets, and are used to describe background noise levels at the ferry terminal.

Vibratory installation of 30-inch steel piles will produce the greatest extent of underwater noise, approximately 174 dB_{RMS}. Background underwater noise levels at the Mukilteo terminal were measured within different frequency ranges. The lowest level was 122 dB_{RMS} (Laughlin 2011) and was therefore the frequency used to calculate the action area. Using NMFS's practical spreading model, 174 dB_{RMS} would attenuate to the background level at approximately 18.2 miles from the source, but in this case will hit land before it reaches that distance. Underwater noise levels will be monitored during impact pile driving (Appendix C).

Temporary Turbidity Increases

Impacts on water quality during construction were modeled for this project (see Effects Analysis section for more detail). Temporary increases in turbidity will occur during vibratory pile installation and removal (primarily pile removal). Any temporary turbidity is expected to be localized to the immediate work area, and is unlikely to extend beyond a 150-foot radius surrounding the piles (Coast & Harbor Engineering 2012a).

Dredging and stone column installation will increase turbidity levels to a greater extent than that caused by pile removal due to the greater volume of sediment that will be disturbed. Modeling of stone column installation impacts on water quality conducted for this project indicate that turbidity would decrease to 5 NTU above background concentrations at about 177 ft (Coast & Harbor Engineering 2012a; Figure 4).

Turbidity can also be generated during dredging but is typically localized to a permitted "mixing zone" that allows increased turbidity within a 300-foot radius from the dredge activity. Modeling of dredging impacts on water quality show that turbidity would reach background concentrations within about 300 ft (Coast & Harbor Engineering 2012a). Turbidity will be monitored during in-water work for this project as required by permit conditions to ensure mixing zone requirements are met.

Stormwater Dilution Zones

Stormwater dilution zones from discharge points along Possession Sound were modeled using the HI-RUN model to calculate pollutant loads and concentrations, and the CORMIX model, which calculates the area in which stormwater pollutants decrease to background concentrations. These models predict that the largest dilution plume is for dissolved zinc

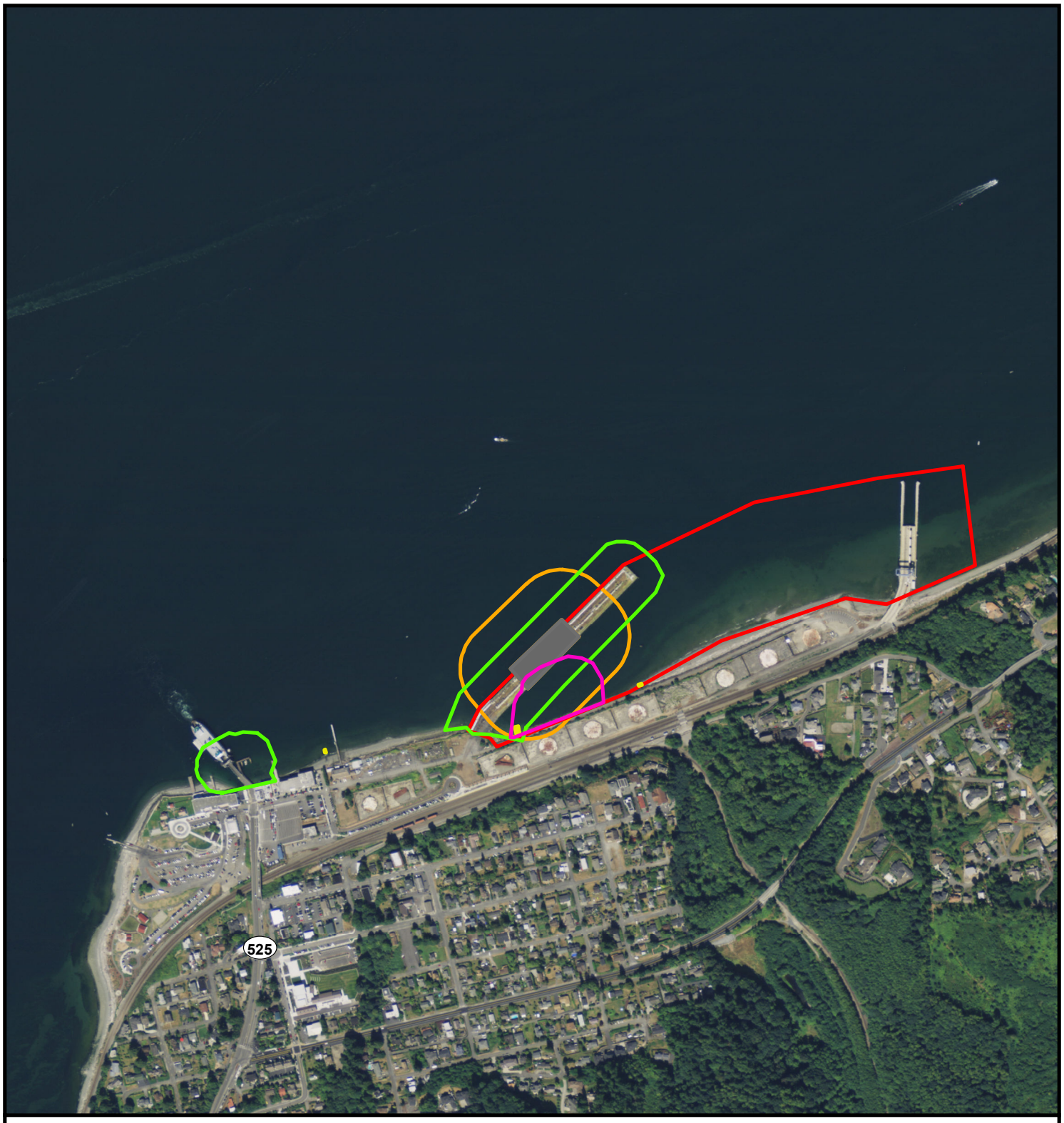

Figure 4. Extent of impacts from turbidity, stormwater, and sediment transport.

0 0.05 0.1 0.2 Miles

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Extent of turbidity from pile removal
Extent of turbidity from dredging
Stormwater dilution plumes
Extent of turbidity from stone columns
Relative increase in longshore sediment transport

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(DZn) from outfall #5-30, which dilutes to 5.6 ug/L above background concentrations (the concentration established by the Services as the threshold for potential water quality effects on salmonids) within 46.2 ft of the outfall (Figure 4).

Sediment Transport

WSF investigated potential impacts to longshore sediment transport as a result of removing the Tank Farm pier. The analysis demonstrated that sediments that have accumulated underneath the pier may be mobilized by wind and wave action and travel generally west to east. Tank Farm pier removal could result in a relative increase in sediment transport of up to 1,800 ft east of the pier for portions of the mound that are in water depths of -15 MLLW or shallower (sediments at deeper depths are outside the littoral system). Most of the sediments and any resuspended contaminants would settle in the old dredge channel east of the pier and in the immediate vicinity of the project area (Coast & Harbor Engineering 2012b) (Figure 4).

Dredged Material Disposal

Any material within the dredge prism that meets DMMP standards will likely be disposed of at the Port Gardner unconfined open water disposal site, the closest open water disposal site to the project. The DMMP has been consulted on separately. Extensive documentation on the DMMP and consultation history can be found on the US Army Corps of Engineers Seattle District website at http://www.nws.usace.army.mil/Missions/CivilWorks/Dredging/Reports.aspx.

Extent of Action Area

The action area is depicted in Figure 5 and has been defined by predicted noise levels from impact pile driving. Based on the distance at which in-air propagation of pile driving noise attenuates to background levels, the in-air extent of the action area is approximately 10,000 ft (1.89 miles) from the project footprint over water, and 3,500 ft over land. The in-water extent of the action area is bounded by nearby land masses. The area defined by potential in-water noise impacts also includes areas affected by temporary turbidity increases, dilution zones for pollutants in stormwater discharge, and any areas potentially affected by changes in sediment transport as a result of project activities (Figure 4), as well as the Port Gardner open-water disposal site.

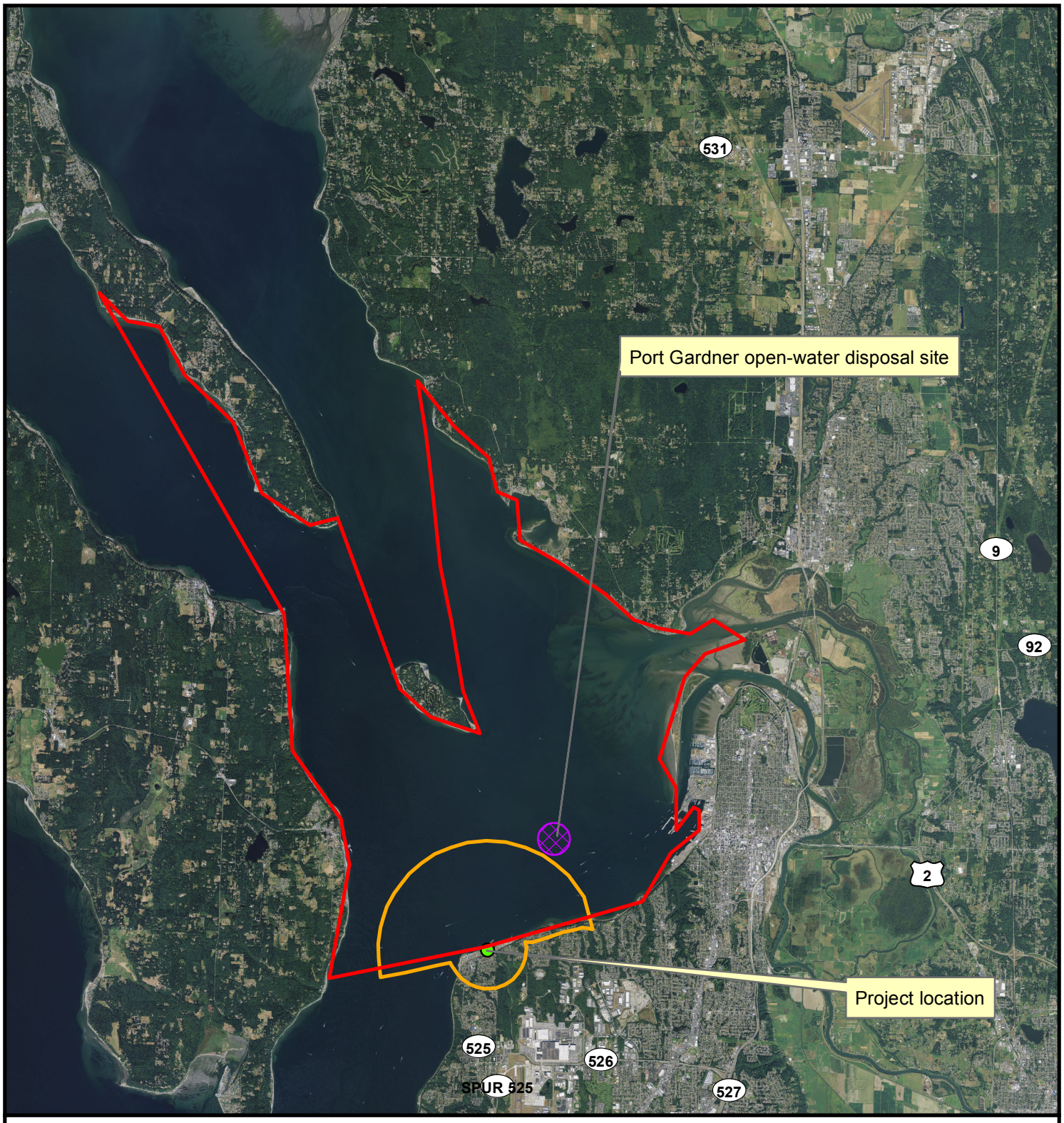

Figure 5. Project action area.

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3. Environmental Baseline

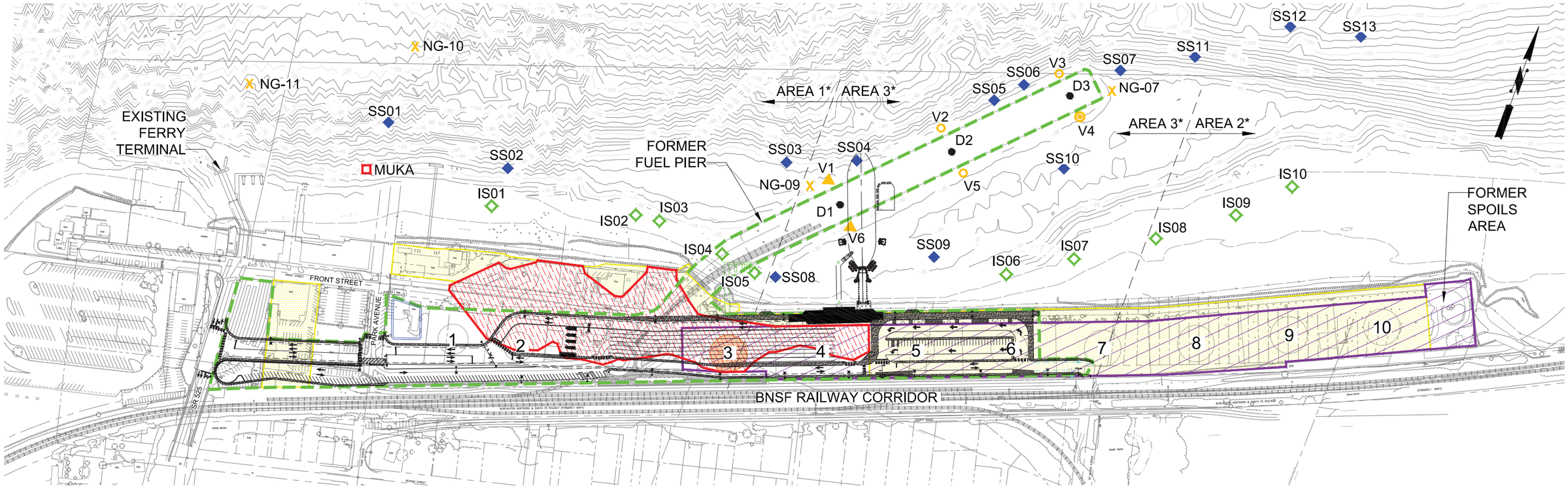
Environmental baseline information for the Mukilteo Ferry Terminal is provided in Section 4.12.1 of the WSF BAR (p. 350). The information in the BAR describes marine and shoreline conditions at the existing ferry terminal. Upland areas in the vicinity of the existing terminal are almost entirely developed with commercial and residential development. What little vegetation exists near the terminal is non-native landscaped vegetation.

Upland areas near the proposed terminal location are mostly on the Tank Farm property, which consists of approximately 20 acres of upland commercial and waterfront property and 13 acres of adjacent offshore property. The upland portion of the property is about 12 ft above mean sea level and is graded and flat. A protective riprap wall, approximately 10 ft high, separates the property from Possession Sound. Vegetation on the property is almost entirely non-native and consists of small trees, shrubs, and herbaceous plants, although there are some small native black cottonwoods (*Populus trichocarpa*) and red alders (*Alnus rubra*) on the site. Extensive pockets of native vegetation are present in Japanese Gulch, Brewery Gulch, and Edgewater Creek Gulch, off the Tank Farm property.

The Tank Farm property was contaminated as a result of past industrial uses, particularly when the site served as a fuel storage and loading facility. In the 1970s and 1980s hazardous materials such as petroleum hydrocarbons, volatile organic compounds, polychlorinated biphenyls, and heavy metals were detected in the soil, groundwater, surface water, and sediments. The Air Force conducted a cleanup of the site in the 1990s and early 2000s. A groundwater remediation treatment system of fuel product recovery, vapor extraction, and air sparge subsystems was installed on the west and east portions of the tank farm. This system operated on at least a portion of the site from 1997 until 2002, when performance monitoring of groundwater and surface water indicated that contaminants were not detected or were found at concentrations below the site-specific cleanup levels. The Washington State Department of Ecology stated that no further monitoring was required and monitoring wells could be abandoned in 2006. No environmental covenant or deed restriction has been entered against the property and the site was removed from the Ecology Hazardous Sites List in 2008.

Soil contamination was nevertheless discovered on the site during archaeological investigations for the Mukilteo Multimodal Project. WSDOT/WSF commissioned a study of soil and groundwater contamination on the Tank Farm property in 2006. Investigations revealed elevated levels of petroleum hydrocarbons and benzene, toluene, ethylbenzene, and xylenes, although most were below Model Toxics Control Act (MTCA) cleanup levels. The majority of contamination appears to occur on the western portion of the property near the former fuels laboratory and slop tank (Figure 6).

The Hazardous Materials Discipline Report (DR) published in support of the Draft Environmental Impact Statement for this project contains much greater detail on



Perimeter Sediment Samples

YEAR	SAMPLE ID	DEPTH	COCs[1]
1983	MUKA	SURFACE	fluoranthene
1986	NG-07	SURFACE	acenaphthene
	NG-09		benzoic acid
	NG-10		phenol
	NG-11		acenaphthene, phenol, fluorene
2003	SS01 - SS13	SURFACE	No Exceedences
	IS01 - IS10		
2012	V1/V6	0-4' (composite)	chlordanes
	V2/V5		
	V3/V4		
	V1/V6	4-8' (composite)	No Exceedances
	V3/V4		chlordanes
	V4	8-12' (discrete)	++

++PAHs (indeno(1,2,3-c,d)pyrene, benzo(g,h,i)perylene, dibenz(a,h)anthracene), pyrene, total HPAHs

Under Pier Sediment Samples

YEAR	SAMPLE ID	DEPTH	COCs
2012	D1	0-4' (discrete)	No Exceedences
	D2		
	D3		
	D2	4-8' (discrete)	Archived; not analyzed
	D3		

Soil Samples

- Surface impacted soil: COCs = petroleum hydrocarbons, PAHs; confirmed 2007 [2]
- 8-12' bgs impacted soil: COCs = petroleum hydrocarbons, BTEX, PAHs; confirmed 2007 [2]
- Suspected, impacted surface soil (petroleum hydrocarbons, pesticides, metals, PAHs)
- Suspected, impacted soil 8-12' bgs (petroleum hydrocarbons, BTEX and/or PAHs)
- Mukilteo multimodal project boundary
- ——— Proposed alternative features

COCs = contaminants of concern
PAHs = polycyclic aromatic hydrocarbons
BTEX = benzene, toluene, ethylbenzene and xylene
bgs = below ground surface
NFA = no further action
SMS = sediment management standards
SQS = sediment quality standards
DMMP = dredge material management program
SL/ML = screening level/maximum level
MTCA = Model Toxics Control Act

Notes:
1. Sediment COCs encountered at concentrations greater than DMMP SL/ML and/or SMS SQS.
2. Soil COCs encountered at concentrations greater than MTCA A cleanup levels and/or site specific cleanup levels.
3. Ecology granted the site an NFA in 2006. Under the agreed order no cleanup levels were promulgated for petroleum hydrocarbons. There is the potential that shallow soil (0-8' bgs) and groundwater in the upland portion of the site are impacted by petroleum hydrocarbons, PAHs and BTEX based on the historical site use.
4. The sediment sample locations shown are approximate.

*Areas as identified in the "Mukilteo Multimodal Project Draft Environmental Impact Statement Hazardous Materials Discipline Report" January 2012

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WASHINGTON STATE FERRIES

DRAWN BY
DESIGN BY
CHECK BY
PROJ MGR

MUKILTEO MULTIMODAL PROJECT SITE: ASSESSMENT

Figure 6. Project features and confirmed and suspected contaminants of concern.

DRAWING NO.
PROJECT NO. FAWAT-07-859
DATE:
SHEET NO.

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contaminants of concern detected at the Tank Farm property. Tables 2 and 3 (located in Part 2 of the DR) summarize analytical results for soil samples collected in 2006 and 2007. The DR can be found online at http://www.wsdot.wa.gov/Projects/Ferries/mukilteoterminal/multimodal/library.htm.

Additional information on the aquatic environment at the proposed terminal location is provided below.

Physical Indicators

Tank Farm Pier

A large pier, known as the Tank Farm pier, currently occupies the site of the proposed terminal. The Tank Farm pier was used by the US Army for munitions transport and by the US Air Force for fuel loading. The 3.17-acre pier contains approximately 3,900 12-inch diameter creosote-treated timber pilings (Figure 7).

Substrate and Slope

Substrates in the vicinity of the proposed terminal are primarily sand and silt. Riprap is found in the high intertidal area, and extends approximately 20 ft from the shore (Figure 8 and Figure 9). Substrates underneath the Tank Farm pier also contain large chunks of concrete that have fallen off the pier, as well as shell hash from shellfish that cover the pilings.

The beach is steeply sloped at this location, dropping to about 30 ft below MLLW within 75 ft of the shoreline. A ship's berth was dredged along the east side of the Tank Farm pier in the late 1940s and still remains, with elevations east of the pier approximately 38 ft below MLLW. Water depth is shallower closer to the Tank Farm pier (-14 MLLW) due to a sediment mound that has accumulated underneath the pier (Figure 9). The mound may have been formed by sediments that drop out of seawater as wave energy is attenuated by the dense placement of pilings underneath the pier, it may have been created deliberately to provide support for the pier, or it may have resulted from placement of dredge material from the dredge channel.

Salt/Freshwater Mixing

Japanese Creek enters Possession Sound through two culverts east of the proposed terminal location. The main discharge point is through a 48-inch culvert underneath the Mount Baker Terminal, approximately 2,500 ft east of the proposed terminal location. A smaller pipe discharges in front of the Tank Farm (Figure 10). The pipe has been buried by recent storms but may still discharge water subsurface.

Brewery Creek enters Possession Sound approximately 1,200 ft west of the proposed terminal (Figure 10). Several City of Mukilteo storm drain systems discharge into Possession Sound in the proposed project vicinity.

Figure 7. Creosote-treated timber pilings supporting the Tank Farm pier.

Groundwater Characteristics

Groundwater levels beneath the Tank Farm property are about seven to 10 ft below the surface elevation. Levels vary with tidal conditions, and range from +6.1 ft above MLLW at low tide to +11.3 ft MLL at high tide. During low tide, groundwater flows north towards Possession Sound; at high tide groundwater reverses direction and flows south. Groundwater is recharged by onsite and offsite infiltration of rainwater, as well as from aquifers in the uplands south of the project area. Most of the project area has been paved, which reduces infiltration of surface water and potential transport of contaminants migrating out of the soil and into Possession Sound.

Figure 8. Riprap along the shoreline east of the Tank Farm pier.

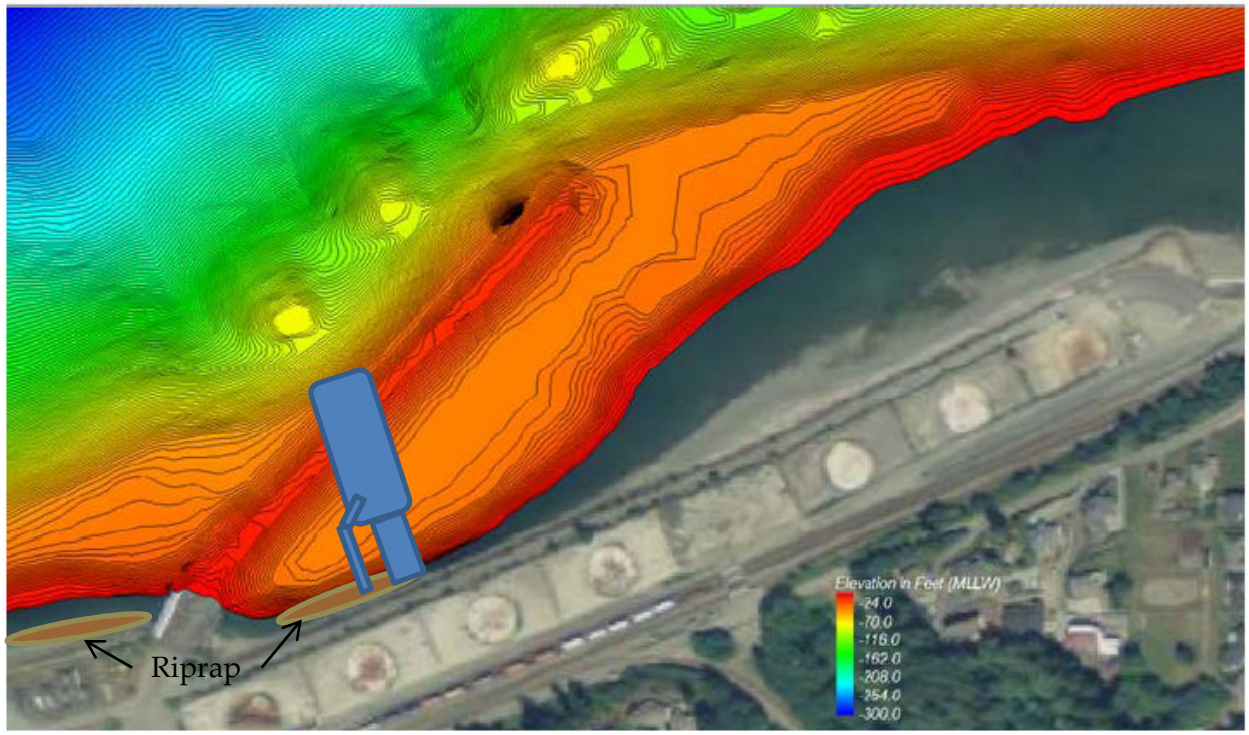

Figure 9. Bathymetry and location of riprap in proposed terminal location.

Figure 10. Location of Japanese and Brewery Creek outfalls.

0 0.05 0.1 0.2 Miles

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Flows and Currents

Current velocities at the base of the Tank Farm pier are fairly small, around 0-0.5 ft/sec, with a maximum of approximately 1.6 ft/sec. Currents run primarily east and west: they flow east during a flood tide and west during ebb tides. Flood tides are stronger than ebb tides. North-south currents are short in duration and small (less than 0.2 ft/sec; Coast & Harbor 2012b).

Chemical Indicators

Water Quality

Possession Sound is classified as extraordinary for aquatic life use per WAC 173-201A-612. No parameters of concern have been identified in Ecology's 2010 303(d) list.

Two outfalls (4-24 and 5-30) on the Tank Farm property currently discharge stormwater runoff from PGIS in the project area. Modeling indicates that dilution plumes for dissolved copper (DCu) extend 12.9 ft from outfall 4-24, and 19.1 ft from outfall 5-30. Dilution plumes for DZn extend 20 and 43.6 ft, respectively.

Sediment Quality

Sediment samples collected in 2003 along the Tank Farm property shoreline did not detect contaminants of concern above reporting limits or above Ecology's SQS. However, in 2009 composite tissue samples for mussels exceeded National Toxics Rule criteria for PCBs and polycyclic aromatic hydrocarbons (PAHs; Ecology 2010).

Core sediment sampling underneath and adjacent to the Tank Farm pier in March and April of 2012 revealed levels of contaminants slightly above DMMP screening level criteria (Figure 6, locations V1-V6). Upper levels of sediment (from 0-8 ft below ground surface [bgs]) were found to contain chlordane, an organochlorine pesticide. PAHs were found in the 8-12 ft bgs core section collected near the northeast end of the pier. The sediment samples were collected approximately three to five ft from the piles and may not have captured PAHs that could have leached into sediments immediately adjacent to the piles. Higher levels of contamination were found toward the eastern end of the Tank Farm pier in deeper water.

Biological Indicators

Macroalgae and Eelgrass

An eelgrass survey conducted by WSDOT/WSF in 2011 found only one small eelgrass patch (less than one square foot) just east of the existing terminal. No eelgrass was found in the footprint of the proposed terminal. The nearest eelgrass beds are on either side of the Mount Baker Terminal, more than 2,000 ft east of the proposed terminal location. The dominant macroalgae at the proposed location were primarily sea lettuce (*Ulva* spp.), with

some northern bladder chain (*Cystoseira geminate*) and kelp (*Laminaria* spp.), and were located close to the shore (Confluence Environmental 2011; Figure 11). Low and moderate densities of macroalgae are shown in green and blue on Figure 11, respectively.

Epibenthos and Macrofauna

Over 50 invertebrate species have been observed in the project vicinity. Sunflower stars (*Pycnopodia helianthoides*) and plumose anemones (*Metridium senile*) were among the most abundant. Dungeness crabs (*Cancer magister*) are particularly abundant underneath the Tank Farm pier. Geoducks (*Panopea abrupta*) were found in surveys east of the pier (Anchor 2005).

Forage Fish

WDFW has documented sand lance spawning beaches between the existing terminal and just west of the Tank Farm pier, as well as east of the Mount Baker Terminal (WDFW 2004) (Figure 12). However, no spawning has been observed on the beach immediately east of the Mount Baker Terminal since the beach was restored after construction of that project. Sand land spawning was documented during monitoring for that project farther east, near the point past the terminal. No other forage fish spawning has been documented in the area (McCartney, pers. comm. 7/19/12).

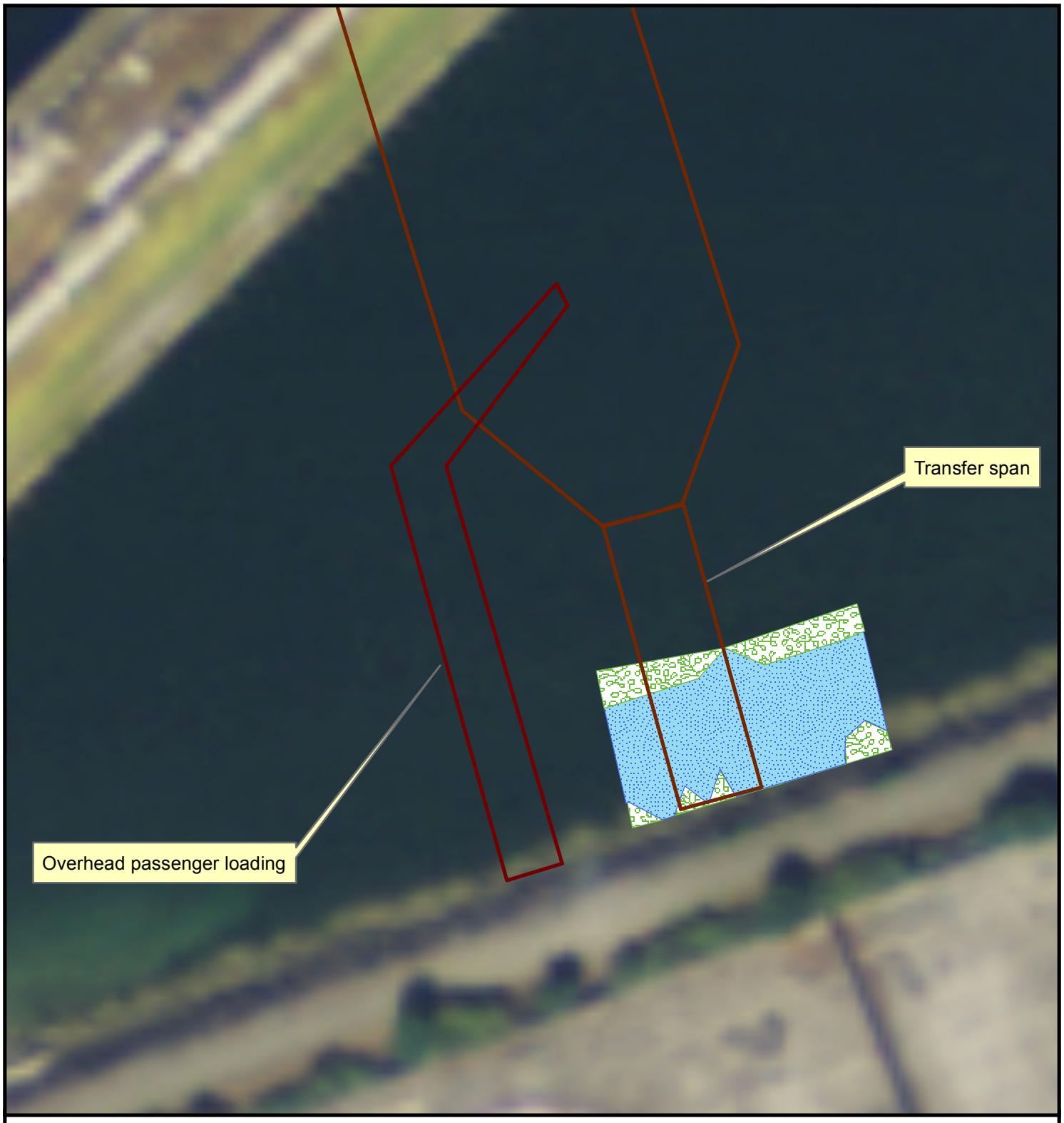

Figure 11. Low-density (green) and moderate-density (blue) macroalgae locations based on 2011 survey data.

0 15 30 60 Feet

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Figure 12. Sand lance spawning beach locations (red lines) in the project vicinity.

0 0.05 0.1 0.2 Miles

N

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4. Species Presence in the Action Area

WSF identified listed or proposed species that may occur within the action area from species lists on the NMFS web site (NMFS 2012) and the USFWS web site (USFWS 2012) (Table 2). WSF obtained information regarding species occurrence and distribution from the WDFW Priority Habitats and Species database in March 2012 and a review of available literature. A WSDOT biologist visited the site on several occasions in 2011 and 2012 to evaluate the project area for the potential presence of listed species and suitable habitat. No listed species were observed during the site visits, but several listed species have been documented in the action area and suitable habitat for listed species occurs within the action area. Suitable habitat for listed fish species includes substrates that support benthic invertebrates and the presence of macroalgae, as well as water quality that would support fish life and unobstructed migration corridors between Possession Sound and the rest of Puget Sound. Suitable habitat for marbled murrelets consists of marine waters of sufficient quality to support forage fish. Suitable habitat for listed marine mammals includes areas of adequate water quality that support prey species and do not obstruct passage.

The Washington Department of Natural Resources Natural Heritage Program database does not indicate that any threatened or endangered plants occur within the action area. No federally listed or proposed plant species have been identified within the action area, nor does suitable habitat for these species exist.

Twelve federally listed animal species are known to occur, or could potentially occur, within the action area. Critical habitat is designated for six of those species but only SR killer whale, PS Chinook salmon, and Coastal-Puget Sound bull trout critical habitat occurs in the action area (Table 2). Critical habitat for Steller sea lion, marbled murrelet, and green sturgeon does not occur in the action area and is not further addressed in this document. Information on species presence at the Mukilteo Terminal is presented in section 4.12.2 of the WSF BAR. The biology of listed species can be found in Appendix B of the WSF BAR.

Table 2. ESA listed species and critical habitat that have been documented or could occur within the project action area.

Species or Critical Habitat	ESA Status
Southern Resident (SR) DPS killer whale (*Orcinus orca*)	Endangered
SR DPS killer whale critical habitat	Designated
Humpback whale (*Megaptera novaeangliae*)	Endangered
Eastern DPS Steller sea lion (*Eumetopias jubatus*)	Threatened
Marbled murrelet (*Brachyramphus marmoratus*)	Threatened
Puget Sound ESU Chinook salmon (*Oncorhynchus tshawytscha*)	Threatened
Puget Sound ESU Chinook salmon critical habitat	Designated
Puget Sound DPS Steelhead (*O. mykiss*)	Threatened
Coastal-Puget Sound DPS bull trout (*Salvelinus confluentus*)	Threatened
Coastal-Puget Sound bull trout critical habitat	Designated
Georgia Basin/Puget Sound DPS bocaccio rockfish (*Sebastes paucispinis*)	Endangered
Georgia Basin/Puget Sound DPS canary rockfish (*Sebastes pinniger*)	Threatened
Georgia Basin/Puget Sound DPS yelloweye rockfish (*Sebastes ruberrimus*)	Threatened
Southern DPS eulachon (*Thaleichthys pacificus*)	Threatened
Southern DPS North American green sturgeon (*Acipenser medirostris*)	Threatened

5. Effects Analysis and Determinations

Biological assessments address direct and indirect effects, effects of interrelated and interdependent actions, and cumulative effects. An interdependent action is an activity that has no independent utility apart from the proposed action. An interrelated action is one that is part of a larger action and depends on the larger action for its justification. Cumulative effects are the effects of future state, local, or private activities, not involving federal activities, which are not attributed to or linked to the project and are reasonably certain to occur within the action area (50 CFR 402.02). No interrelated/interdependent actions were identified for this project; cumulative effects are discussed after the following discussions of direct and indirect effects.

Direct effects

The project could directly affect listed species and critical habitat in the action area. Direct effects to listed species could come from:

- Elevated noise levels during pile driving;
- Increased turbidity created by dredging and stone column installation as well as pile driving and removal;
- Changes to the amount and location of overwater cover;
- Placement of new piers and anchors, as well as removal of existing piers;
- Removal of creosote-treated piles and decking;
- Prop wash and vessel wake;
- Changes in sediment transport that could occur due to removal of the Tank Farm pier;
- Mobilization of contaminated sediments in the project area; and
- Pollutants in stormwater discharge.

Noise

Both impact and vibratory pile driving are necessary for the project. Concrete piles will be driven using an impact hammer. Steel piles will be vibrated into place.

For impact pile driving, noise is described in instantaneous peak sound pressure levels decibels (dB_{PEAK}), which is the maximum overpressure or underpressure observed during each sound pulse. Forty-one 24-inch diameter concrete piles supporting the new terminal and relocated fishing pier will be driven with an impact hammer. Work will last approximately two hours per pile and take place over five days for the terminal and four days for the fishing pier. WSF conducted a test pile project for impact driving of a 24-inch concrete pile at Mukilteo in 2006. Noise levels were 184 dB_{PEAK}/170 dB_{RMS} at 10 m (33 ft) from the source (Laughlin 2007; Table 3).

The transfer span and overhead loading structure will be supported by drilled shafts: two 60-inch diameter drilled shafts for the transfer span, and one 131-inch diameter shaft for the

Table 3. Number and type of piles for project and estimated noise levels that will be generated by pile installation and removal.

Project component	Pile type	Installation/ Extraction method	Estimated noise level[1,2]	Number of piles	Duration per pile	Total pile noise duration
Trestle construction	24-inch concrete	Impact	184dB$_{PEAK}$ 159dB$_{SEL}$ 170 dB$_{RMS}$	14	2 hours	28 hours
Drilled shaft casings – transfer span	60-inch steel	Vibratory	166 dB$_{RMS}$	2	1 hour	2 hours
Stone column	NA	Vibratory	166 dB$_{RMS}$	NA	NA	4 weeks
Drilled shaft casings – OHL	131-inch steel	Vibratory	166 dB$_{RMS}$	1	1 hour	1 hours
Wingwalls	36-inch steel	Vibratory	174 dB$_{RMS}$	14	30 min	7 hours
	18-inch steel	Vibratory	162 dB$_{RMS}$[3]	4	30 min	2 hours
Fixed dolphins	30-inch steel	Vibratory	174 dB$_{RMS}$	36	30 min	18 hours
New terminal building	24-inch concrete	Impact	184dB$_{PEAK}$ 159dB$_{SEL}$ 170 dB$_{RMS}$	8	2	16 hours
Relocated fishing pier	24-inch concrete	Impact	184dB$_{PEAK}$ 159dB$_{SEL}$ 170 dB$_{RMS}$	12	2 hours	24 hours
	12-inch steel	Vibratory	162 dB$_{RMS}$	15	30 min	7.5 hours
Removal of existing terminal and fishing pier	12-inch timber	Vibratory	152 dB$_{RMS}$	290	15 min	72.5 hours
Removal of Tank Farm pier	12-inch timber	Vibratory	152 dB$_{RMS}$	3,900	15 min	975 hours

1. Noise was measured at 10 m from the source except for vibratory removal of steel piles, measured at 16 m.
2. Except where otherwise noted in the text noise data are cited in the WSF BAR.
3. There are no measurements for vibratory installation of 18-inch so they are assumed to produce sound levels similar to 24-inch steel piles.

overhead loading. Steel casings for the drilled shafts will be vibrated into place. It will take approximately one hour to install each shaft; installation will occur over two days. This work will generate noise levels of approximately 166 dB_{RMS} at 10 m (33 ft) from the source (Laughlin pers. comm.; Table 3).

The project will vibrate in 36 30-inch steel piles for the fixed dolphins, and 14 36-inch and four 18-inch steel piles for the wingwalls. . It will take about 30 minutes to install each pile, and will last a total of six days. Vibratory driving of 30-inch steel piles will generate noise levels of approximately 166 dB_{RMS} at 10 m (33 ft) from the source (Laughlin, pers. comm.). 36-inch steel piles will create noise levels of about 174 dB_{RMS}, and 18-inch steel piles will generate noise levels of 162dB_{RMS} (Table 3).

The relocated fishing pier will require 12 24-inch diameter concrete piles to support the pier and 15 12-inch diameter steel piles for fender and guide piles. The concrete piles will be installed with an impact hammer. Steel piles will be installed with a vibratory hammer. Since they are not load-bearing piles no impact proofing will be necessary.

Vibratory removal of wooden piles will also generate noise levels above background. Vibratory extraction of timber piles at the Port Townsend ferry terminal created maximum noise levels of 152 dB_{RMS} 16m from the source (Laughlin 2011b).

There are no data on noise generated by stone column construction, which uses a vibratory probe to inject gravel and crushed rock into the soil. However it is likely similar to other types of vibratory construction methods, such as pile installation, that would generate noise levels of about 166 dB_{RMS}.

Turbidity

Impacts due to turbidity are discussed in Section 3.1.2 of the WSF BAR (p. 93). Turbidity will be generated during pile driving and removal (particularly during pile removal), construction of the stone columns, and dredging of the navigation channel.

Pile removal

Turbidity generated during pile installation and removal tends to be highly localized. The density of piles would not increase turbidity impacts because piles will be removed one at a time, and not all at once; the extent of turbidity would be similar to that observed for other pile removal projects. Turbidity from pile removal will be limited to about a 150-ft radius of the pile (Coast and Harbor Engineering 2012a). Pile removal will occur for about 73 hours over the course of two weeks for the existing terminal, and last as long as ten months (split between two in-water work seasons) for the Tank Farm pier.

Stone columns

Turbidity caused by installation of stone columns will be greater than that generated by pile removal, but also fairly localized. Modeling conducted for this project indicates that

turbidity would decrease to 5 NTU above background levels within about 177 ft of the project footprint (Coast & Harbor Engineering 2012a). Stone columns will be constructed over an area of approximately 25,000 ft² underneath and adjacent to the footprint of the new trestle and OHL. The columns have been sited to avoid contaminated areas (Figure 3).

Dredging

Dredging will also generate turbidity. A navigation channel approximately 500 ft long and 100 ft wide will be dredged from a depth of -14 MLLW to -30 MLLW, for a total volume of approximately 19,500 cy. The extent of turbidity impacts was modeled specifically for this project (Coast & Harbor Engineering 2012a). Turbidity would decrease to 3 NTU above background within 150 ft of the dredged area, and would decrease to background levels at approximately 300 ft.

Dredging will only be necessary during project construction; no maintenance dredging is anticipated throughout the life of the project. It will take approximately 30 days to dredge the navigation channel. BMPs will be deployed during dredging to limit the spread of sediments (see Minimization Measures, above). Dredged material will be sampled for contaminants prior to construction; any dredged that exceed DMMP criteria will be handled and disposed of at approved upland locations per regulations and permit conditions.

Overwater cover

Effects of changes in overwater cover are described in Section 3.1.3 of the WSF BAR. The new trestle and associated structures will create approximately 15,187 ft² of new overwater cover, the new terminal building will increase overwater cover by 2,464 ft², and the relocated fishing pier will result in an additional 3,178 ft² of overwater cover. The project will remove approximately 150,238 ft² (3.45 acres) of existing overwater cover, for a net decrease of overwater cover by 129,409 ft² (2.97 acres; Table 4).

Barges measuring approximately 50 x 150 ft (7500 ft²) will be used to support construction equipment during removal of the Tank Farm pier, removal of the existing terminal, and construction of the new terminal. Demolition of the existing terminal and fishing pier will only take two weeks. The barge used to construct the new terminal will be in place for the longest duration (July – Feb); however, the barge will be moved regularly to access different work areas. Shading impacts from the presence of barges will therefore be minimal.

Benthic habitat

Benthic areas provide habitat for macroalgae and macroinvertebrates that provide a food source for listed fish species (WSF BAR 3.1.3.3, p. 99). Dredging and installation of new piles will both cause impacts to benthic habitat. Dredging will create deeper water habitat (from about -14 to -30 MLLW) that may have less benthic productivity; however, benthic productivity in this area is already limited due to shading from the Tank Farm pier and the presence of closely-spaced piles. Dredging will have a large footprint, (approximately

Table 4. Net change in overwater cover due to project construction

Project component		Overwater cover (ft²)
Construction	New trestle	15,187
	New terminal building	2,464
	Relocated fishing pier	3,178
Construction Total		*20,829*
Demolition	Existing trestle	10,128
	Fishing pier	2,030
	Tank Farm pier	138,080
Demolition Total		*150,238*
Decrease in overwater cover		129,409

48,000 ft²), and will create deeper habitat that receives less light, but the dredge prism will still provide habitat for benthic organisms. Macrofauna species found in the area have rapid recolonization rates and would recover within about a year. Recolonization may be limited in shallower areas closer to the terminal where ferry prop wash will continually disturb sediments. Installation of stone columns will also disrupt benthic habitat. However this impact will be temporary as benthic organisms recolonize the sediment layer above the columns.

Pile installation will result in permanent impacts to benthic habitat. Removal of piles for the existing terminal and Tank Farm pier will offset those impacts, resulting in a net increase in benthic habitat post-project. The project will install 14 concrete piles for construction of the new trestle; two piles for the transfer span; one casing for the overhead loading structure; 18 piles for the fixed dolphins and wingwalls, and 27 piles for the relocated fishing pier, filling a total of 321 ft² of benthic habitat. However, the project will remove 248 piles from the existing terminal, 42 piles from the existing fishing pier, and over 3,900 piles from the Tank Farm pier, for a net gain of about 2,886 ft² of benthic habitat (Table 5).

Propwash Scour and Vessel Wake Wash

WSDOT/WSF examined potential impacts to bottom sediments and shoreline erosion as a result of propwash scour and vessel wake wash if the terminal were moved to a new location. Modeling results for the proposed terminal location demonstrated a small and localized scour hole approximately 1.4 ft deep could develop at a depth of approximately -20 to -25 ft MLLW, located 40 to 50 ft offshore from the MHHW shoreline (Coast & Harbor Engineering 2012b). A small scour hole at this depth would have minimal impacts to benthic habitat.

Table 5. Changes in benthic habitat due to project construction

Project component		Number of piles	Size of piles (diameter)	Total area (ft²)
Construction	New trestle	14	24-inch	44
	Transfer span	2	60-inch	39
	Overhead loading	1	131-inch	94
	Fixed dolphins	18	30-inch	88
	Wingwalls	4	18-inch	7
		14	36-inch	100
	New terminal building	8	12-inch	6
	Relocated fishing pier	12	24-inch	38
		15	12-inch	12
Construction Total		*70*		*428*
Demolition	Existing trestle	248	12-inch	195
	Fishing pier	42	12-inch	33
	Tank Farm pier	3,930	12-inch	3,087
Demolition Total		*4,220*		*3,315*
Total benthic habitat gain				**2,886**

A scour hole approximately 2.2 ft deep has formed at the existing terminal at a depth of -25-35 ft MLLW. This scour hole will gradually fill in due to natural longshore sediment transport processes once the existing terminal is removed, allowing for restoration of benthic habitat in that location.

Changing the location of the ferry terminal could also change the energy and direction of vessel wake wash propagating from the ferry to the shoreline. The analysis demonstrated that wake wash will arrive at the shoreline with very little energy. Wave heights from ferry wake wash reaching the shoreline are not expected to exceed 0.6 ft. In comparison, wave heights during yearly storms range from two to three feet (Coast & Harbor Engineering 2012b). Ferry wake wash will therefore not contribute to shoreline erosion that could affect listed species.

Sediment Transport

WSDOT/WSF examined impacts of the Tank Farm pier removal on longshore sediment transport and on the stability of sediments underneath the pier. There are two potential concerns: first, sufficient sediment could be mobilized to reduce light levels or even bury macroalgae, particularly eelgrass beds east of the pier. Second, the sediment mound contains contaminated material which, if disturbed, could affect biological resources in the project vicinity. This section discusses the potential for increased longshore sediment transport and movement of the sediment mound; the next section analyzes potential effects of contaminants in the sediment mound.

The tightly-spaced pilings that support the Tank Farm pier reduce wave energy. Modeling results demonstrate that removing the pier would likely increase wave energy and thus increase longshore sediment transport along the shoreline, particularly during storms coming from the west and northwest. During a 25-year storm event, the potential distance for longshore sediment transport could increase by as much as 1,800 ft over current conditions (Coast & Harbor Engineering 2012b).

The sediment mound underneath the pier ranges in height from -11 ft MLLW near the landward portion of the pier to -19 ft MLLW farther seaward. Removal of the Tank Farm pier may mobilize sediments underneath the pier during a five- to ten-year or higher return period storm. However, because the crest of the sediment mound is in relatively deep water, only the top few feet of the mound will be affected; sediments shallower than -15 ft MLLW are outside the littoral system (Coast & Harbor Engineering 2012b). Unless an extreme storm event occurs (25-year return period or greater) the rate of erosion of the mound would be slow and any erosion would likely not even be detectable for the first five to ten years after removal of the Tank Farm pier (Coast & Harbor Engineering 2012b).

In the event of a 25-year storm, sediments with a diameter less than 2 mm (very coarse sand) may be eroded from the mound, leaving more stable sediments. These would form an armor layer consisting primarily of coarse sand and gravel on the surface of the mound (predominantly gravel). An estimated 1,050 cy of material would be eroded from the mound during a 25-year storm event, if one were to occur immediately after pier removal. Some of this material would settle in the deepwater depression on the landward side of the pier. Only about half of the material would travel beyond the depression and deposit downcurrent. Even if all the material were to deposit within 2,000 ft from the pier it would form a layer only about 0.08 inches thick (Coast & Harbor Engineering 2012b).

Sediment mobilization due to removal of the Tank Farm pier is therefore not likely to have a measureable impact on macroalgae or aquatic life in the project vicinity. Only a small portion of the mound underneath the pier will be affected, reducing the amount of material that could be mobilized at one time, and the erosion rate will be slow. Even in the event that a large storm mobilizes most of the erodible material shortly after the Tank Farm pier is removed, and all of that material were deposited in the immediate vicinity of the pier, it

would form only a very thin layer of sediment along the seabed. Macroalgae in the project vicinity are therefore not likely to be affected.

Contaminated Sediments and Soils

Upland Contamination

Due to the site's past history as a fuel storage and distribution facility, the Tank Farm property has some areas of soil contaminated. Both surface samples and deeper borings have revealed elevated levels of petroleum hydrocarbons, PAHs, BTEX (benzene, toluene, ethylbenzene, and xylenes), and metals (lead and silver), all of which can be detrimental to aquatic life.

The project has been designed to avoid impacts to areas of known contamination, where possible. The terminal building, bulkhead, trestle, and bridge seat (project components with the deepest foundations) will all be constructed outside areas with known surface or below ground soil contamination (Figures 3 and 6). In addition, fill up to seven feet deep will be placed over some areas, effectively capping contamination (Appendix A).

Project features requiring excavation may encounter confirmed or suspected contaminants of concern in groundwater and/or soil during construction on the upland portion of the site. Additional testing will occur in those areas prior to construction to better characterize the extent and type of contamination. Any contaminated soils encountered during construction will be removed and disposed of at existing upland facilities permitted to accept contaminated waste. Transport of contaminated material will use existing haul routes, such as state highways. The contractor will provide bills of lading to WSDOT to ensure that contaminated materials have been disposed of properly.

Groundwater in excavation areas will be characterized prior to the start of construction so interim remedial actions can be identified. The analytical results from groundwater samples will identify areas where dewatering water needs to be collected in portable water storage tanks, sampled, and disposed of at an appropriate disposal facility. If water is clean it will be discharged to a storm drain. Contaminated water will be disposed of via sanitary sewer under the NPDES permit for the project, or transported to an offsite facility that is suitable for the disposal of contaminated groundwater.

Upland construction still has the potential to spread contaminated material. Pressure created by stone column installation could force contaminated soil or groundwater through the ground and into nearshore areas of the Tank Farm property. Modeling conducted for this project, indicate that effects of stone column installation would be unlikely to extend beyond approximately 177 ft from the project footprint (see Construction impacts modeling results, below).

Water quality will be monitored during stone column installation to ensure turbidity and associated contaminants do not extend beyond 150 ft. Water quality monitoring will be conducted from shoreline or by boat and will include visually monitoring surface water conditions as well as collecting surface and near surface grab samples whenever potential increases in turbidity (such as bubbles or sediment plumes) are observed.

The project will construct stormwater facilities to treat stormwater prior to discharge to Possession Sound. Stormwater facilities will be constructed within the layer of clean fill on the site, and will be designed (using lined ponds, for example) to avoid contaminated areas and infiltrating into potentially contaminated soils. Slopes for stormwater pipes will be minimized to avoid deep trench excavations that could encounter contaminated soil or groundwater.

Marine Contamination

In March and April 2012 sediments were sampled adjacent to and underneath the Tank Farm pier. Core samples were collected at below ground depths of 0-4 ft, 4-8 ft, and 8-12 ft. at water depths ranging from -17 to -35 MLLW. Chlordane and other organochlorine pesticides were detected at depths of 0-4 ft and 4-8 ft, with PAHs in the 8-12 foot layer. Higher levels of contamination were detected in deeper water at the eastern end of the pier. Samples were collected three to five feet from the base of the piles and may not have captured elevated levels of PAHs that could have leached into sediments immediately surrounding the piles.

Preliminary results indicated most of the sediments do not exceed DMMP screening level criteria; however, concentrations of chlordane and PAHs did exceed those criteria. Chlordane can be lethal to salmonids at levels as low as 8 ppb, and can have lethal and sublethal effects to various aquatic species that salmonids eat (Eisler 1990).

As discussed above, removal of the Tank Farm pier could mobilize sediments at depths less than - 15 ft MLLW. Sediments at the 4-12 ft bgs layer are in depths of 18-26 ft below MLLW, and are well below the -15 MLLW depth. These sediments are therefore not likely to be mobilized by wave action once the Tank Farm pier is removed. Only the upper layers of sediment would be mobilized post-project. Sediments would generally drift from west to east. Most of the sediment would settle into the dredged area east of the Tank Farm pier.

Construction impacts modeling results

WSF analyzed temporary water quality impacts caused by dredging, pile removal, and stone column installation. Using current velocity data, bottom sediment samples, and water quality criteria, WSF modeled the extent of turbidity that would be generated by each of those activities.

Dredging

Dredging the navigation channel will disturb potentially contaminated sediments. Preliminary sediment sampling indicated that sediments within the dredge prism contain lower levels of contamination than sediment samples taken closer to the end of the pier. Additional testing will take place prior to construction to determine whether dredged sediments meet DMMP criteria for open water disposal. Dredged sediments that do not meet the criteria will be disposed of at appropriate upland locations.

Turbidity during dredging will be limited to a permitted mixing zone extending 300 feet from the dredge activity. Modeling results indicate that sediments disturbed by dredging will settle out of the water column within about 150 ft of the dredge prism: turbidity at 150 ft from dredging activities will be less than 3 NTUs over background concentrations, and will decrease to background concentrations within 300 ft of the dredging location (Coast & Harbor Engineering 2012a). Turbidity will be monitored during dredging and will be minimized by implementing standard construction BMPs as well as additional BMPs listed above.

Dredged material that is eligible for open water disposal will be sent to the Port Gardner open water disposal site. The US Army Corps of Engineers consulted with the USFWS and NMFS several times since 2005 regarding the continued use of Puget Sound dredged material disposal sites. The NMFS and USFWS have written concurrence letters agreeing that the DMMP is not likely to adversely affect listed species or critical habitat. The NMFS also issued a Biological Opinion in 2010 indicating that the DMMP will not jeopardize the continued existence of newly-listed rockfish species (USACE 2012).

Pile Removal

The project will remove nearly 4,200 creosote-treated piles and associated decking for the existing terminal, Port of Everett fishing pier, and Tank Farm pier. Creosote contains PAHs which can be detrimental to fish life (WSF BAR p. 100). While many of the piles are old, and much of the creosote from the piles has likely already leached out of the structures, the piles still have the potential to leach more creosote into the surrounding area. The project will remove over 7,300 tons of creosote-treated timber from the environment.

Pile removal could bring to the surface any sediments clinging to the base of the piles along with any contamination in the sediments. Creosote from treated piles often leaches into the surrounding sediments and could be released during pile removal when those sediments are disturbed. Sediments could also be contaminated with other hydrocarbons and pesticides as described above.

A study conducted during the Jimmycomelately Creek pile pulling project analyzed surface sediment samples collected at distances of 2, 6, and 12 inches from 104 creosote-treated timber piles that were pulled from the Jimmycomelately Creek estuary in Lower Sequim Bay, Washington. PAHs were detected in almost all samples, with concentrations generally

highest in samples closest to the pilings. None of the samples at the 12-inch stations exceeded SQL criteria (Weston Solutions and Pascoe Environmental Consulting 2006).

Water quality monitoring during pile pulling events showed that in six of ten events PAH concentrations did not change. In four events PAH concentrations increased, with the highest concentrations generally observed near the seabed. The highest concentrations of PAHs ranged from 100-200 μg/L (Weston Solutions and Pascoe Environmental Consulting 2006). Although there are no Washington State ambient water quality criteria for total PAHs, NOAA guidelines have established 300 μg/L as the lowest observable effects level for total PAHs (NOAA 2003). This value is greater than any taken during pile pulling events (Weston Solutions and Pascoe Environmental Consulting 2006).

Turbidity observed during the Jimmycomelately pile pulling events was within 5 NTUs of background at 60 to 150 ft from the pile, although much of the observable turbidity may have been cause by tug boat movement and not pile pulling. Water quality monitoring conducted for a pile removal project in Anacortes did not detect any increase of turbidity above 10 NTUs over background within 150 ft from the work area, and turbidity monitoring for a wharf removal project in San Francisco did not generate any measureable increase in turbidity 20 ft from the piles.

Pile removal is therefore not likely to cause a large increase in turbidity and associated contaminants, and would generate far less turbidity than dredging. However, pile removal will occur over a large area (3.17 acres for Tank Farm pier removal) and during an extended time period (two in-water work seasons). The project will use vibratory pile removal to the extent possible to minimize turbidity, but use of a clamshell or cutting piles at the mudline may be necessary if piles cannot be removed using the vibratory method. Therefore the turbidity plume generated by pier removal is conservatively estimated to extend 150 ft from the project footprint.

Stone column installation

Stone column installation may increase pore pressure within the soil that could re-suspend bottom sediments during construction. This action was simulated as a discharge pipeline that releases suspended sediment into the water column and modeled as a turbidity plume extending from the pipe outlet. The model showed that increases in turbidity at 150 ft from the stone column installation location would be about 6.8 NTUs above background concentrations (Coast & Harbor 2012a). This is consistent with other stone column installation projects in which bubbles and turbidity plumes have been observed about 75-150 ft from the project footprint (see photos, below).

Stone columns are located in areas where contamination is not expected to be present (Figure 3). Stone column construction will last approximately four weeks. Turbidity will be monitored during stone column installation. If water quality exceedances are observed, the contractor will decrease the outflow velocity of the water/air jet.

Stormwater

Stormwater generated by roadways contains pollutants detrimental to aquatic life. The primary constituents of concern are total suspended solids (TSS), total copper (TCu), dissolved copper (DCu), total zinc (TZn), and dissolved zinc (DZn). Dissolved copper reduces olfactory responsiveness in juvenile salmonids in freshwater in laboratory studies (Baldwin et al. 2003), and fish have shown avoidance reactions to elevated levels of dissolved zinc (Sprague 1968). In a recent study on copper in seawater, juvenile Chinook salmon demonstrated an avoidance response of dissolved copper at levels as low as 18 µg/L (Sommers 2012). However, standards for effects to salmonids have not yet been established for saltwater, so freshwater standards were used for this analysis. The Services have established a behavioral threshold level of 2 µg/L above the background concentration for DCu and 5.6 µg/L above the background concentration for DZn (WSDOT 2012).

The project area currently generates stormwater runoff in one threshold discharge area (TDA), which discharges untreated to Possession Sound through five outfalls. Three of the outfalls are 8-inch diameter drains from the Tank Farm property that drain only non-PGIS (these outfalls are shown in Figure 3). The other two outfalls are 24-inch and 30-inch diameter drains that drain PGIS (Figure 13). There is no information on water quality of discharges from existing outfalls.

Figure 13. Locations of project stormwater outfalls.

0 137.5 275 550 Feet

N

Washington State Department of Transportation

Existing impervious surface in the project area totals 41.26 acres, only 2.43 acres of which is PGIS. The project will create an additional 10.2 acres of PGIS, mostly by converting the impervious surface of the Tank Farm property to roadway and holding areas. PGIS will discharge via the 24-inch and 30-inch diameter outfalls as well as one additional outfall (6-XX) that will be constructed on the eastern edge of the project (Table 6; Figure 13). The new stormwater pipe will be within the clean fill material placed on the site (Appendix A). The 8-inch pipes will be abandoned in place. All new PGIS will be treated using enhanced treatment (Filterra systems). No detention will be provided since stormwater discharges to Possession Sound, which is exempt from flow control requirements.

WSF will sweep the Mukilteo Terminal holding areas on a quarterly basis with a vacuum sweeper, which will reduce pollutants entering stormwater treatment BMPs. The level of reduction is difficult to quantify and has not been accounted for in this analysis. Therefore the numbers presented here likely overestimate pollutant loads and dilution distances.

Table 6. Pre- and Post-Project PGIS

Outfall	Existing PGIS (ac)	Treatment type (area)	New PGIS (ac)	PGIS Post-Project (ac)	Treatment type
#4-24	1.89	None	3.0	4.89	Filterra
#5-30	0.54	None	4.57	5.11	Filterra
#6-XX	0	None	2.63	2.63	Filterra
Total	*2.43*	---	*10.2*	*12.63*	---

Pollutant loads and concentrations were analyzed using the HI-RUN program approved by WSDOT and the Services per the 2009 Memorandum of Agreement (http://www.wsdot.wa.gov/NR/rdonlyres/F39C7232-6A97-43C2-AC47-185167D7E8D0/0/BA_AssessingStormwaterEffects.pdf). Cormix Version 6.0GT was used as the dilution modeling program for analyzing DZn and DCu dilution plumes. Dilution plumes were modeled using the median DCu and DZN concentrations produced by the HI-RUN model. Model inputs and detailed results are presented in Appendix D.

Pollutant Loads and Concentrations

The project will provide enhanced treatment for all new PGIS; however, except for TSS, the project's additional PGIS will still increase overall pollutant loads (Table 7).

Table 7. Pre- and Post-Project Pollutant Loads

Outfall	Scenario	Pollutant Load (lb/yr)				
		TSS	TCu	DCu	TZn	DZn
#4-24	*Existing*	1,540	0.192	0.044	1.16	0.33
	Proposed	253	0.095	0.059	0.45	0.30
	Difference	-1287	-0.097	+0.015	-0.710	-0.030
	Percent change	-83.6%	-50.5%	+34.1%	-61.2%	-9.1%
#5-30	*Existing*	215	0.055	0.013	0.333	0.094
	Proposed	168	0.15	0.089	0.69	0.46
	Difference	-47	+0.095	+0.076	+0.357	+0.366
	Percent change	-21.9%	+172.7%	+584.6%	+107.2%	+389.4%
#6-XX	*Existing*	0	0	0	0	0
	Proposed	97	0.084	0.051	0.04	0.27
	Difference	+97	+0.084	+0.051	+0.04	+0.27
	Percent change	NA	NA	NA	NA	NA

Concentrations of pollutants decline for all pollutants of concern by as little as 25% for DCu to over 90% for TSS (Table 8). [Note that concentrations are the same for all outfalls because pre-project concentrations are the same for all PGIS, and post-project concentrations are determined by the type of treatment provided, which is identical for the three outfalls.]

Table 8. Pre- and Post-Project Pollutant Concentrations

Scenario	Pollutant Concentrations (mg/L)				
	TSS	TCu	DCu	TZn	DZn
Existing	61.35	0.016	0.004	0.095	0.027
Proposed	5.68	0.005	0.003	0.023	0.016
Percent change	***-91%***	***-69%***	***-25%***	***-76%***	***-41%***

Dilution Analysis

Dilution modeling estimates the distance at which pollutants of concern (specifically DCu and DZn) in stormwater runoff reach the threshold established by the Services for potential water quality effects to salmonids (there are no thresholds for saltwater, so the analysis used

the freshwater thresholds of 2 μg/L above the background concentration for DCu and 5.6 μg/L above the background concentration for DZn). There are no data on ambient DCu and DZn concentrations for Possession Sound but they are likely similar to those measured for Elliott Bay: 0.07 μg/L for DCu and 4.1 μg/L for DZn (Curl et al. 1988). Dilution distances for DZn will increase slightly post-project. For outfall #4-24, the distance at which DCu in stormwater discharge will dilute to 2ug/L above the background concentration is 12.9 ft. DZn will be diluted to 5.6 ug/L above background concentrations within 21 ft of the outfall. For outfall #5-30, the dilution distance is 19.1 for DCu and 46.2 for DZn, and it is 4.71 ft and 15.5 ft for outfall #6-XX (Table 9). Fish swimming along the nearshore could therefore be exposed to a larger area of elevated levels of pollutants post-project.

Table 9. Pre- and post-project dilution distances (ft)

Outfall	Pollutant	Pre-Project	Post-Project
#4-24	DCu	12.9	12.9
	DZn	20.0	21.0
#5-30	DCu	19.1	19.1
	DZn	43.6	46.2
#6-XX	DCu	0	4.71
	DZn	0	15.5

Beneficial Effects

Construction of the proposed project will have several beneficial effects to listed species as described above and summarized here.

- Overwater cover: The project will decrease overwater cover by approximately 3.09 acres.
- Migration barrier: Removal of the Tank Farm pier will eliminate a large barrier to salmonid migration along the nearshore.
- Benthic habitat: Removal of the Tank Farm pier and existing terminal will create a net gain of benthic habitat of approximately 2,886 ft^2
- Removal of creosote-treated timber: The project will remove over 7,300 tons of creosote-treated timber piles and decking from the aquatic environment.

Species-Specific Effects Analysis

Direct and indirect effects to each species that could occur in the action area are detailed in the following sections.

SR DPS Killer Whale (Orcinus Orca)

Southern resident (SR) distinct population segment (DPS) killer whale presence near the ferry terminal is described in the WSF BAR Section 4.12.2.5 (p. 357). The action area for the project covers all or part of quads 382, 383, 384, 385, and 386. Sightings compiled by NMFS and the Orca Network from 1990-2012 for various months show that SR killer whales occur most frequently in the area in the fall and winter, and are far less common from April through September (NMFS 2010; Orca Network 2012; Table 10).

Table 10. Total killer whale sightings per month in the project action area between 1990 and 2008. Months corresponding to the in-water work window are highlighted in green.

Month	Number of sightings
July	0
August	3
September	5
October	20
November	20
December	22
January	18
February	7
March	15
April	7
May	14
June	0

Effects Analysis

Direct effects on SR killer whale from this project could occur from in-water noise due to pile driving and removal. Analysis of direct effects on SR killer whale is described in the WSF Reference BA Section 3.2 (p. 106-108). Indirect effects include potential impacts to prey species.

Underwater Pile Driving Noise

For cetaceans, NMFS has established an underwater noise injury level of 180 dB_{RMS} for impulse noises, such as that created by impact pile driving, and a disturbance threshold of

160 dB_{RMS} for impulse noises and 120 dB_{RMS} for continuous noise, such as that created by vibratory pile driving. The project's impact pile driving will generate noise levels of only 170 dB_{RMS}, well below the injury threshold. Impact pile driving noise will attenuate to the disturbance threshold of 160 dB_{RMS} within approximately 152 ft (0.03 miles) of the project footprint (Table 11; Figure 14). It is highly unlikely that SR killer whales would be found so close to the terminal.

Table 11. Noise levels produced by different pile types and installation methods and associated marine mammal disturbance distances (ft[mi]).

Pile type	Installation/ Extraction method	Estimated noise level	Disturbance distance (by species)		
			SR killer whale	Humpback whale	Steller sea lion
24-inch concrete	Impact	170 dB_{RMS}	152 (0.03)	152 (0.03)	152 (0.03)
Timber pile removal	Vibratory	152 dB_{RMS}	5,249 (0.99)	3,861 (0.73)	5,249 (0.99)
12-inch steel	Vibratory	162 dB_{RMS}	15,228 (2.88)	11,202 (2.12)	15,228 (2.88)
Drilled shaft casings (all diameters)	Vibratory	166 dB_{RMS}	28,140 (5.33)	20,701 (3.92)	28,140 (5.33)
30-inch steel	Vibratory	174 dB_{RMS}	96,084 (18.2)	70,684 (13.39)	96,084 (18.2)

Vibratory driving of steel casings and piles will generate noise levels of up to 174 dB_{RMS} measured at 32.8 ft (10 m) from the source (WSDOT 2012), and vibratory removal of piles used to support the existing terminal, fishing pier, and Tank Farm pier will create underwater noise levels of approximately 152 dB_{RMS} at 16 m from the source (Laughlin 2011b), exceeding the disturbance threshold for vibratory pile driving of 120 dB_{RMS}. However, the background noise level at the Mukilteo Ferry Terminal within the functional hearing range for SR killer whales was recently measured at 122 dB_{RMS} (Laughlin 2011). The distance at which noise from vibratory pile driving will attenuate to 122 dB_{RMS} ranges from 2.88 miles for 12-inch steel to 18.2 miles for 30-inch steel (the extent of the action area; Figure 15). Noise from vibratory installation of steel piles will only last a total of 37.5 hours (Table 3). Although noise from vibratory removal of timber piles will last much longer (975 hours), the impacts are much smaller: noise from timber removal will attenuate to 122 dB_{RMS} within 0.99 miles of the source (Figure 15; Table 11). If any SR killer whales were to enter this zone

Figure 14. Marine mammal underwater noise disturbance threshold zone from impact pile driving and in-air Steller sea lion disturbance threshold zones for impact and vibratory pile driving.

N

0 0.01 0.02 0.04 Miles

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- Trestle footprint
- Steller sea lion in-air vibratory disturbance zone
- Steller sea lion in-air impact disturbance zone
- Impact pile driving underwater disturbance zone for all marine mammals

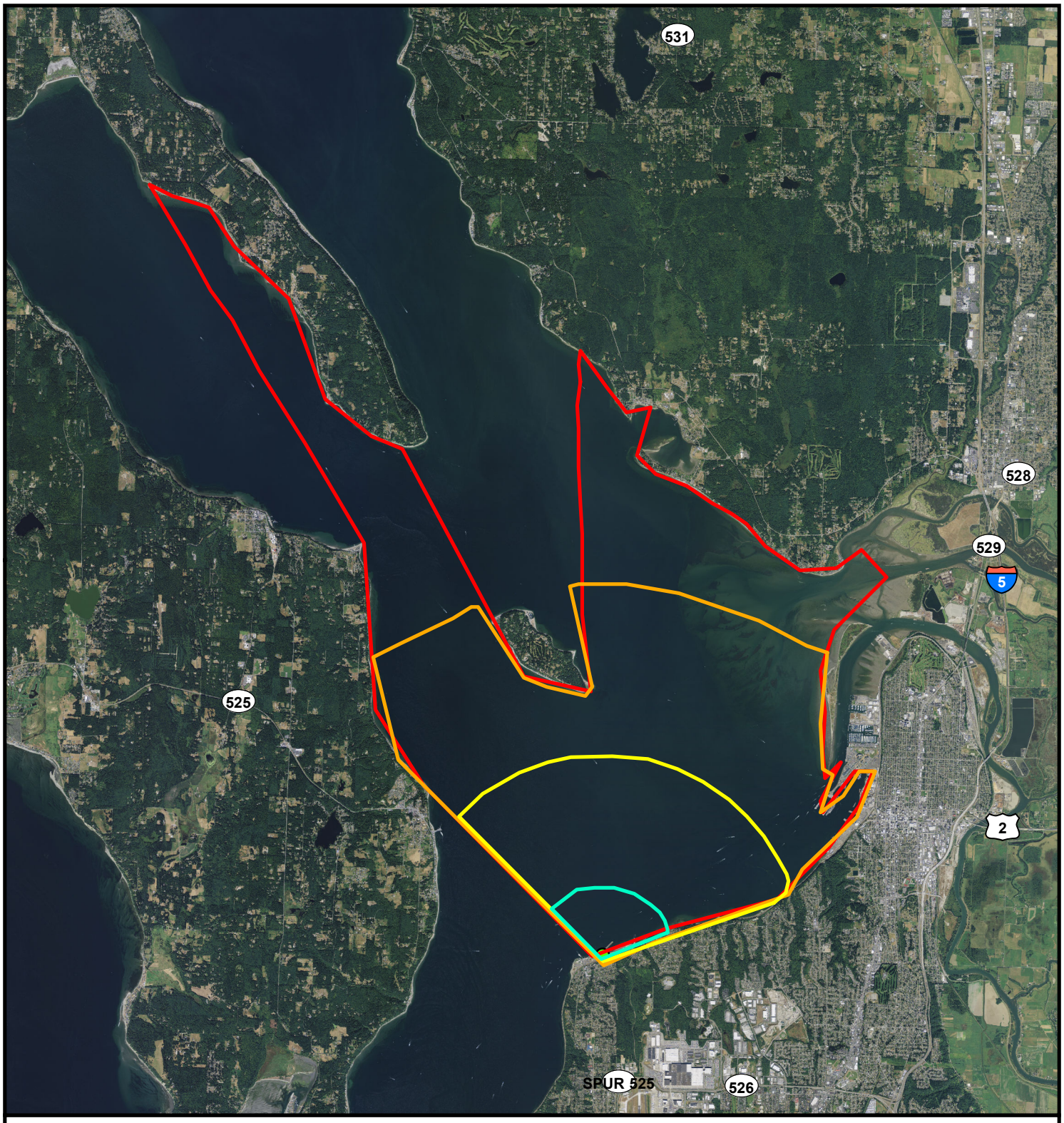

Figure 15. SR killer whale and Steller sea lion vibratory pile driving disturbance threshold zones.

0 0.5 1 2 Miles

N

Timber
12-inch steel
18 and 24-inch steel
30 and 36-inch steel

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during vibratory pile driving they could be temporarily disturbed and exhibit behavioral changes.

An Incidental Harassment Authorization will be obtained for this project to address acoustical harassment of SR killer whales during pile driving and removal.

Potential Effects to Prey

The rivers and streams of central Puget Sound support runs of Puget Sound Chinook, coho, chum, pink, sockeye and steelhead, all of which provide food sources for SR killer whale (NMFS 2008). The Snohomish, Stillaguamish Rivers and Skagit rivers are all located near the Mukilteo ferry terminal. Forecasts for salmon that may return to those rivers in 2012 are 5,769 Chinook; 232,350 coho; and 145,765 chum. The run forecast for Puget Sound sockeye (which includes the Baker River and Lake Washington runs) is 81,327 (WDFW 2012). Forecast numbers for steelhead and pink are not available.

Potential effects to prey species include in-water noise due to impact pile driving, temporary increases in turbidity, potential mobilization of contaminated sediments, and an increase of pollutants in stormwater runoff. Noise from impact pile driving could injure fish less than two grams within 108 feet from the source, and fish greater than two grams within 59 ft from the source. BMPs will be implemented during construction to minimize the spread of turbidity and contaminated sediments, and enhanced stormwater treatment has been incorporated into the project design to minimize pollutant loads discharged to Possession Sound. Project construction will also result in several beneficial impacts to prey species, such as a reduction of overwater cover, elimination of a large nearshore migration barrier (the Tank Farm pier), increase in benthic habitat, and removal of creosote-treated timber. Potential project impacts to prey species are described in detail in the effects analysis for listed salmonids in the WSF BAR Section 4.1.2.

Effect Determination

A **may affect** determination is warranted for SR killer whale because:

- SR killer whales have been documented in the action area and occur more commonly during the in-water work window.
- Pile driving and removal will produce in-water noise levels that exceed the disturbance threshold for cetaceans.

The project is **likely to adversely affect** SR killer whale because:

- Any SR killer whale present in the area of potential disturbance during pile driving and removal may be acoustically harassed.

The potential for impacts to SR killer whales is reduced by the following factors:

- SR killer whales are extremely unlikely to be found in the impact pile driving disturbance zone during construction.
- Vibratory installation of steel piles and casings will be short-term.
- The project will be designed, and BMPs implemented, to minimize the potential impacts on prey species from turbidity and contaminated sediments. Any dredged sediments that do not meet DMMP criteria will be disposed of at approved upland locations.
- Reduction of overwater cover, an increase in available benthic habitat, and removal of over 7,300 tons of creosote-treated timber will benefit SR killer whale prey species.

Minimization measures described in WSF BAR Section 2.3, as well as in this document, will be implemented to minimize potential impacts to SR killer whale and prey species.

Designated Critical Habitat

SR killer whale designated critical habitat and PCEs at the Mukilteo Terminal are described in the WSF BAR Section 4.12.2.6 (p. 358). The following PCEs for critical habitat are present in the project action area:

- PCE #1: Water quality to support growth and development.
- PCE #2: Prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth.
- PCE #3: Passage conditions to allow for migration, resting, and foraging.

Effects Analysis

Direct effects on SR killer whale critical habitat from this project may occur from in-water noise due to pile driving and removal, temporary increases in turbidity that could mobilize contaminated sediments, and increased pollutant loading in stormwater runoff (WSF BAR Section 3.2, p. 106).

Noise generated by pile driving may injure or kill SR killer whale prey in the immediate vicinity of pile driving: fish ≤2 g could be injured within 108 feet of impact pile driving, and fish > 2 g could be injured with 59 ft of the source (see effects analysis for listed salmonids, below). Noise could also temporarily disturb killer whales in the action area, thereby impeding passage conditions. The greatest extent of underwater noise impacts will be from vibratory installation of steel piles and casings; however, the duration for vibratory installation is relatively short (37.5 hours total; Table 3).

Turbidity will be generated by pile removal, installation of stone columns, and dredging. Sediments in the project area may be contaminated with compounds harmful to fish. BMPs will be implemented to minimize the spread of sediments and any potentially contaminated material. Any dredged sediments that do not meet DMMP standards will be disposed of at an appropriate upland location. Enhanced stormwater treatment will be provided for

stormwater runoff to minimize pollutant loads entering Possession Sound; however, creation of additional PGIS will result in increased pollutant loads.

The project will result in beneficial effects to prey species by reducing overwater cover, increasing benthic habitat, and removing creosote-treated piles.

Effect Determination

A **may affect** determination is warranted for SR killer whale critical habitat because:

- The project is located within designated SR killer whale critical habitat.
- Pile driving and removal will produce in-water noise levels that exceed the disturbance thresholds for cetaceans.
- Noise from impact pile driving will exceed the fish injury thresholds.
- Pile removal, installation of stone columns, and dredging will increase turbidity in the project area.
- Construction activities could disturb contaminated sediments in the project area.

The project is **likely to adversely affect** designated SR killer whale critical habitat because:

- If SR killer whales are present in the action area during pile driving and/or removal, then acoustic disturbance may impede passage conditions (PCE #3).

The potential for impacts to SR killer whale critical habitat is reduced by the following factors:

- SR killer whales are extremely unlikely to be found within the impact disturbance zone of 152 ft during pile driving.
- Vibratory installation of steel piles and casings will be short-term.
- In-water construction will be limited to the in-water work window when salmonids are least likely to be present in the nearshore.
- Though a low number of SR killer whale prey species individuals may be affected by the project, construction will not significantly affect the distribution or abundance of prey species in the action area.
- The project will be designed to minimize disturbing contaminated sediments; any dredged sediments in the project footprint that do not meet DMMP standards will be disposed of at an approved upland location.
- The project will provide enhanced stormwater treatment to minimize pollutants discharged to Possession Sound.
- Minimization measures described in WSF BAR Section 2.3 (2.3.1, 2.3.2, and 2.3.3) will be implemented to minimize potential impacts to water quality and prey species.

The project will also result in several beneficial effects to SR killer whale critical habitat:

- The project will reduce overwater cover by more than three acres.

- Removal of the Tank Farm pier will eliminate a large barrier to nearshore migration.
- The project will result in an increase of 2,886 ft^2 of benthic habitat.
- The project will remove over 7,300 tons of creosote-treated timber from the aquatic environment.

Humpback Whale (Megaptera novaeangliae)

Humpback whale presence near the Mukilteo terminal is discussed in Section 4.12.2.4 of the WSF BAR (p. 356). Sightings are rare: only four individuals have been reported in the vicinity of the terminal in the past ten years. Two were observed in April and one in September of 2002, and one in April of 2004 (Orca Network 2012).

Effects Analysis

Direct effects on humpback whale from this project could occur from in-water noise due to vibratory pile driving and removal. Analysis of direct effects on humpback whale is described in the WSF BAR Section 3.3 (109). Indirect effects include potential impacts to prey species.

Underwater Pile Driving Noise

As with SR killer whales, NMFS has established an underwater noise injury level of 180 dB_{RMS} for impulse noises, and disturbance thresholds of 160 dB_{RMS} for impulse noises and 120 dB_{RMS} for continuous noise. Impact pile driving will generate noise levels of 170 dB_{RMS}, which is below the injury threshold. Impact pile driving noise will attenuate to the disturbance threshold of 160 dB_{RMS} within approximately 152 ft (0.03 miles) of the project footprint (Figure 14). Humpback whales are extremely unlikely to venture so close to the terminal.

Vibratory pile driving of steel casings and piles will generate noise levels of up to 174 dB_{RMS} measured at 32.8 ft (10 m) from the source; vibratory removal of timber piles will create elevated underwater noise levels of approximately 152 dB_{RMS} at 16 m from the source (Laughlin 2011b; Table 11). The background noise level at the Mukilteo Ferry Terminal within the functional hearing range for humpback whales was recently measured at 124 dB_{RMS} (Laughlin 2011a). The distance at which vibratory pile driving of steel casings and piles will attenuate to 124 dB_{RMS} ranges from 2.12 to 13.39 miles (Figure 16; Table 11); the distance at which vibratory removal of timber piles will attenuate to 124 dB_{RMS} is 0.73 miles (Figure 16). If any humpback whales were to enter this zone during vibratory pile driving they could be temporarily disturbed and exhibit behavioral changes. Vibratory installation of steel piles and casings will only occur for a short time (37.5 hours) during construction (Table 3).

Humpback whales are unlikely to occur in the action area during pile driving, which would warrant an effect determination of "may affect, not likely to adversely affect". However, the action area is too large to effectively monitor. The effect determination is therefore "likely to

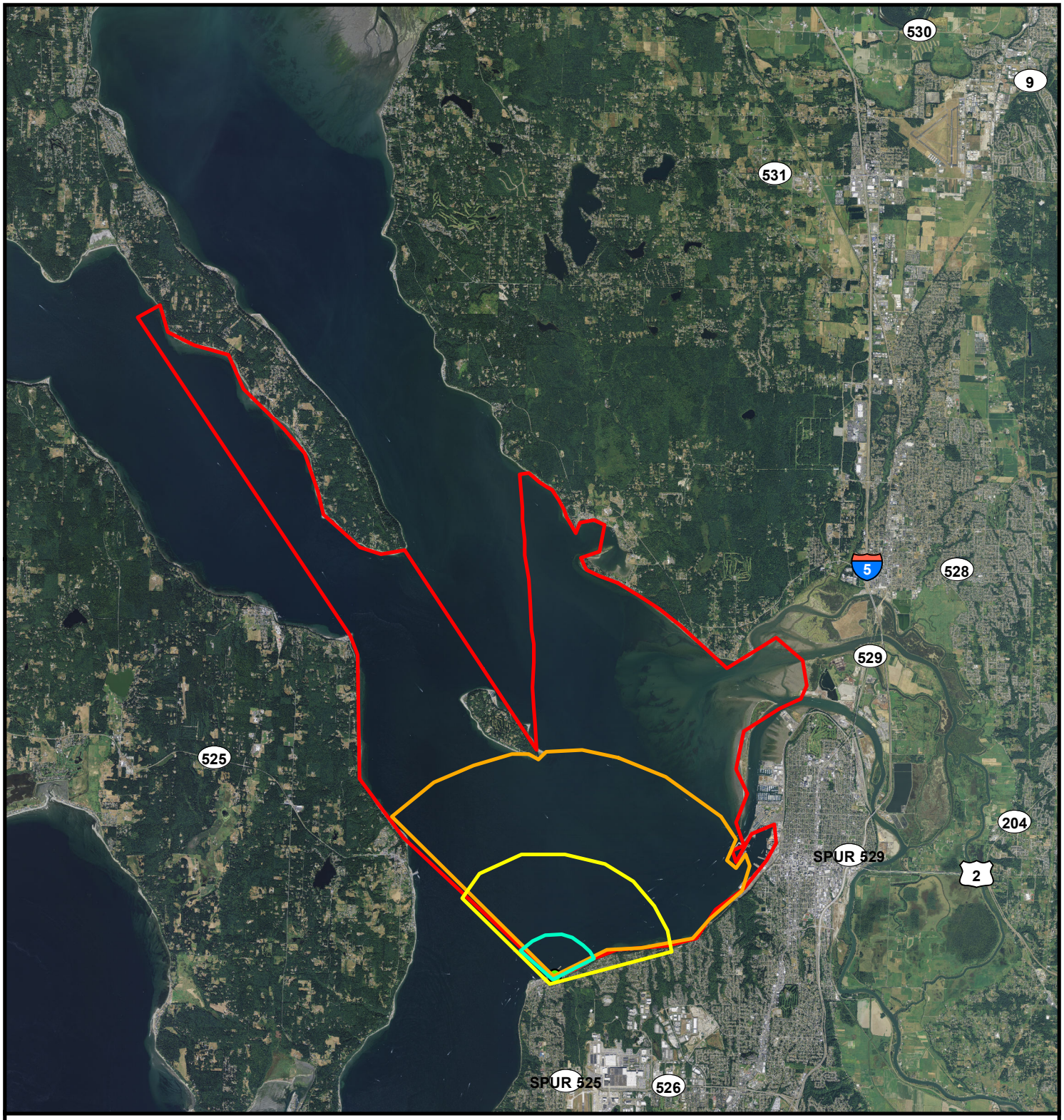

Figure 16. Humpback whale vibratory pile driving and removal disturbance threshold zones.

0 0.5 1 2 Miles

N

Timber
12-inch steel
18 and 24-inch steel
30 and 36-inch steel

Washington State Department of Transportation

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adversely affect" and the project will obtain an Incidental Harassment Authorization to address acoustical harassment of humpback whales during pile driving and removal.

Potential effects to prey species

Humpback whales eat a variety of benthic and pelagic organisms, but primarily herring, which are found throughout Puget Sound (WSF BAR, Appendix B). These organisms could be affected by in-water noise due to impact pile driving, temporary increases in turbidity during pile installation and removal, installation of stone columns, and dredging, mobilization of contaminated sediments and increased pollutant loads in stormwater. However, these species will also benefit from a reduction of overwater cover, increase in benthic habitat, and removal of creosote-treated timber. There are no documented herring spawning beds in the action area (WDFW 2004).

Effect Determination

A **may affect** determination is warranted for humpback whale because:

- Humpback whales could be present in the action area.
- Pile driving and removal will produce in-water noise levels that exceed the disturbance threshold for cetaceans.

The project is **likely to adversely** affect humpback whale because:

- If humpback whales are present in area of potential disturbance during vibratory pile driving and/or removal, they may be acoustically harassed.

The potential for impacts to humpback whale is reduced by the following factors:

- Humpback whales are extremely unlikely to be found in the impact pile driving disturbance zone during construction.
- Vibratory installation of steel piles and casings will be short-term.

The potential for impacts to humpback whale prey species are reduced by the following factors:

- The nearest herring spawning locations are in Port Susan, several miles from the project footprint.
- Though a low number of humpback whale prey species individuals may be affected within the immediate work zone during pile driving and removal, installation of stone columns, and dredging, in-water work will not significantly affect the distribution or abundance of prey species in the action area.
- The project will be designed to minimize disturbing contaminated sediments; any dredged material in the project footprint that does not meet DMMP standards will be disposed of at an approved upland location.

- The project will provide enhanced stormwater treatment to minimize pollutants discharged to Possession Sound.
- Minimization measures described in WSF BAR Section 2.3 (2.3.1, 2.3.2, and 2.3.3) will be implemented to minimize potential impacts to water quality and prey species.

The project will also result in several beneficial effects to humpback whale prey species:

- The project will reduce overwater cover by more than three acres.
- The project will result in an increase of about 2,886 ft^2 of benthic habitat.
- The project will remove over 7,300 tons of creosote-treated timber from the aquatic environment.

Eastern DPS Steller Sea Lion (Eumetopias jubatus)

Steller sea lion presence near the ferry terminal is described in the WSF BAR Section 4.12.2.7 (p. 149). The closest haulouts are Rich Passage buoys, 19 miles southwest of the terminal, and Craven Rock, 23 miles northwest of the terminal. Haulouts are generally occupied from October through May, which overlaps with the in-water work window.

Effects Analysis

Direct effects on Steller sea lion from this project may occur from in-water and in-air noise due to pile driving and removal and temporary increases in turbidity. Analysis of direct effects on Steller sea lion is described in the WSF BAR Section 3.4 (p. 110). Indirect effects include potential effects on prey species.

Pile Driving Noise

NMFS has established an underwater noise injury threshold for pinnipeds of 190 dB_{RMS}, and a disturbance threshold of 160 dB_{RMS} for impulse noise and 120 dB_{RMS} for continuous noise. Impact pile driving noise will not exceed the injury threshold. Impact pile driving noise will attenuate to the disturbance threshold of 160 dB_{RMS} within approximately 152 ft (0.03 miles) of the construction site (Figure 14). Steller sea lions are unlikely to be found so close to the terminal during construction.

Vibratory pile driving will generate noise levels of up to 174 dB_{RMS}, and vibratory pile removal will generate noise levels of 152$dB_{RMS,}$ exceeding the disturbance threshold of 120 dB_{RMS}; however, background noise levels at the Mukilteo Ferry Terminal within the functional hearing range for Steller sea lions is 122 dB_{RMS} (Laughlin 2011). The distance at which noise from vibratory driving of steel casings and piles will attenuate to 122 dB_{RMS} ranges from 2.88 to 18.2 miles; noise from vibratory removal of timber piles will attenuate to 124 dB_{RMS} is 0.73 miles (Figure 15; Table 11). If any Steller sea lions were to enter these zones during vibratory pile driving or removal they could exhibit behavioral changes. Vibratory installation of steel piles and casings will only occur for a short time (37.5 hours total) during project construction.

NMFS has established an unweighted in-air noise disturbance threshold of 100 dB_{RMS} for sea lions. Impact pile driving of concrete piles will generate noise levels of approximately 110 dBA at 50 ft, which is approximately equivalent to the 100 dB_{RMS} threshold (Figure 14). No unweighted in-air data is available for vibratory pile removal. Unweighted in-air measurements of vibratory driving of a 30-inch steel pile collected during the 2010 Keystone Ferry Terminal Wingwalls Replacement Project ranged from 95-97.8 dBA at 50 ft. (Laughlin 2010). Removal of pile in-air noise levels is conservatively assumed to be the same as pile driving. Using a conservative measurement of 97.8 dBA at 50 ft., and attenuating at 6 dBA per doubling distance overwater, in-air noise from vibratory pile removal and driving will attenuate to the 100 dBRMS threshold within approximately 39 ft (Figure 14). Steller sea lions are extremely unlikely to be found within 39 feet of the terminal during construction.

Steller sea lions are unlikely to occur in the action area during pile driving, which would warrant an effect determination of "may affect, not likely to adversely affect". However, the action area is too large to effectively monitor. The effect determination is therefore "likely to adversely affect" and the project will obtain an Incidental Harassment Authorization to address acoustical harassment of Steller sea lions during pile driving and removal.

Potential Effects to Prey

Steller sea lion feeding is described in the WSF BAR Appendix B (p. B-11). Prey species could be affected by in-water noise due to impact pile driving, temporary increases in turbidity during pile installation and removal, installation of stone columns, and dredging, mobilization of contaminated sediments, and increased pollutant loads in stormwater. Beneficial effects to prey species will result from a reduction of overwater cover, increase in benthic habitat, and removal of creosote-treated timber.

Effect Determination

A **may affect** determination is warranted for Steller sea lion because:

- Steller sea lion have been documented in the action area.
- Pile driving and removal will produce in-water noise levels that exceed the disturbance thresholds for pinnipeds.

The project is **likely to adversely affect** Steller sea lion because:

- If any Steller sea lions are present in the area of potential disturbance during pile driving and removal, they may be acoustically harassed.

The potential for impacts to Steller sea lion is reduced by the following factors:

- There are no haulouts within the action area.
- Steller sea lions are extremely unlikely to be found in the impact pile driving disturbance zone during construction.

- Vibratory installation of steel piles and casings will be short-term.

The potential for impacts to sea lion prey is reduced by the following factors:

- In-water construction will be limited to the in-water work window when salmonids are least likely to be present in the nearshore.
- Though a low number of Steller sea lion prey species individuals may be affected within the immediate work zone during impact pile driving and dredging, in-water work will not significantly affect the distribution or abundance of prey species in the action area.
- Any dredge sediments in the project footprint that do not meet DMMP standards will be disposed of at an approved upland location.
- Minimization measures described in WSF BAR Section 2.3 (2.3.1, 2.3.2, and 2.3.3) will be implemented to minimize potential impacts to water quality and prey species.

The project will also result in several beneficial effects to Steller sea lion prey species:

- The project will reduce overwater cover by more than three acres.
- The project will result in an increase of about 2,886 ft^2 of benthic habitat.
- The project will remove over 7,300 tons of creosote-treated timber from the aquatic environment.

Marbled Murrelet (Brachyramphus marmoratus)

Marbled murrelet presence near the ferry terminals is described in the WSF BAR Section 4.12.2.12 (p. 363). Marbled murrelet forage near the ferry terminal and lighthouse from April through August and are found in the area intermittently at other times of the year. There is no nesting habitat in the action area.

Effects Analysis

Direct effects on marbled murrelet from the project include in-air noise and underwater noise from pile installation and removal and temporary increases in turbidity. Indirect effects include potential effects on prey species.

Noise impacts

Sound exposure level (SEL) is another metric used as an indicator of sound energy transmitted to a receiver and is calculated by summing the cumulative pressure of the sound integrated over time. For underwater noise from impact pile driving, USFWS has set a non-injurious auditory threshold (above which temporary hearing loss could occur) of 183 dB_{SEL}, an injurious auditory threshold (the level at which hearing damage could occur) of 202 dB_{SEL}, and a non-auditory injury (barotrauma) threshold of 208 dB_{SEL}. A behavioral response threshold has been established at 150 dB_{RMS}. There are no thresholds for vibratory pile driving.

Impact pile driving will create underwater noise levels of 184 dB_{PEAK} (170 dB_{RMS}). Approximately 300 pile strikes will be required for each pile. About five piles will be installed per day, for a total of 1,500 estimated number of pile strikes per day, generating 191 dB_{SEL} (Appendix E). The distance at which impact pile driving noise will attenuate to 150 dB_{RMS} is approximately 707 ft. The distance at which pile driving noise will attenuate to 183 dB_{SEL} is 108 ft (Figure 17). Pile driving noise could elicit a behavioral response, such as disruption of foraging or avoidance of the area, from any marbled murrelets within that zone during construction.

Noise will reach the auditory injury threshold of 202 dB_{SEL} within 6 ft, and the barotrauma threshold of 208 dB_{SEL} at 3.3 ft. If any marbled murrelets enter this area during impact pile driving they could be injured. It is extremely unlikely that marbled murrelets will be present within the injury zone during construction given the tiny radius of the zone and level of disturbance near the trestle.

USFWS has established an in-air noise behavioral response threshold for marbled murrelets of 92 dBA. Impact pile driving could generate in-air noise levels of up to 110 dBA at 50 ft from the source (WSDOT 2012). Noise levels will attenuate to 92 dBA within about 400 ft from the source (Figure 17). Vibratory installation of piles will generate noise levels of approximately 97.8 dBA at 50 ft from the source (WSDOT 2010). Noise from vibratory pile installation will attenuate to 92 dBA within about 85 ft of the source (Figure 17). If marbled murrelet were to enter the 400-foot radius during impact pile driving or 85-foot radius during vibratory pile driving, they could avoid the area or exhibit other behavioral changes.

The project will implement a monitoring plan to avoid impacts to marbled murrelets and stop impact pile driving if any murrelets are observed within the non-injurious threshold zone during construction (Appendix B).

Turbidity

Turbidity will be generated during in-water work for pile removal, construction of the stone columns, and dredging. Work will take place during the in-water work window (July 15 – Feb 15). Turbidity could interfere with the birds' ability to forage; however, project timing and high levels of disturbance in the vicinity during construction would minimize the likelihood of marbled murrelets foraging near construction activities.

Any murrelets that are present during construction could also be exposed to contaminants in disturbed sediments.

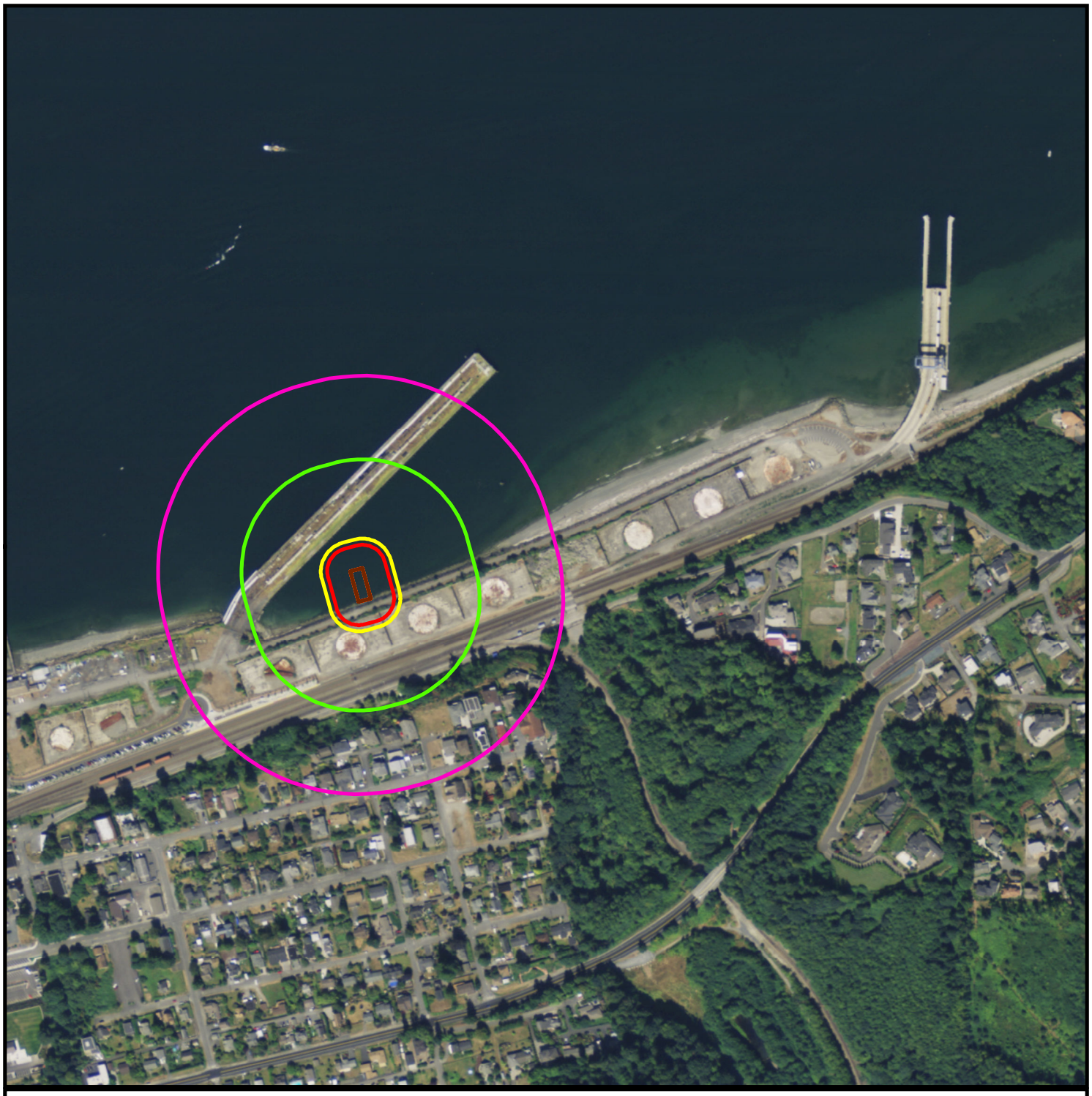

Figure 17. Disturbance and non-injurious auditory threshold zones for marbled murrelets by impact pile driving.

- Trestle footprint
- In-water non-injurious threshold shift zone
- In-air noise behavioral response zone for vibratory pile driving
- In-air noise behavioral response zone for impact pile driving
- In-water behavioral response threshold zone

0 0.0375 0.075 0.15 Miles

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Potential Effects to Prey

Marbled murrelet foraging is described in the WSF BAR Appendix B (p. B-31). They feed primarily on fish as well as small crustaceans and invertebrates. Prey species could be affected by in-water noise due to impact pile driving, temporary increases in turbidity during pile installation and removal, installation of stone columns, and dredging, mobilization of contaminated sediments, and increased pollutant loads in stormwater. Beneficial effects to prey species will result from a reduction of overwater cover, increase in benthic habitat, and removal of creosote-treated timber. Impacts to marbled murrelet prey species would be similar to those described for listed fish species and their prey, below.

Effect Determination

A **may affect** determination is warranted for marbled murrelet because:

- Marbled murrelet may be present near the terminal during construction.
- Impact pile driving will generate in-air and underwater noise levels above the injury and behavioral response thresholds established by the USFWS.
- In-air noise from impact pile driving may occur during prebasic molting (July 15-October 31) when marbled murrelet are unable to fly, and a portion of the April 1 to September 15 breeding season (July 15 – September 15).
- Temporary increases in turbidity from dredging and pile removal will occur.

The project is **not likely to adversely affect** marbled murrelet because:

- A monitoring plan will be implemented to avoid impacts to marbled murrelets. If a murrelet is observed within the non-injurious threshold zone (Figure 17) impact pile driving will be stopped until the bird has moved out of the area.
- Marbled murrelets are highly unlikely to venture into the potential injury zone during impact pile driving.
- Marbled murrelet are not known to nest near the ferry terminal site and there is no suitable nesting habitat for marbled murrelet in the vicinity of the site.
- Impact pile driving will only last 68 hours over two weeks.

Impacts to marbled murrelet prey species are reduced by the following factors:

- Though a low number of marbled murrelet prey species individuals may be affected within the immediate work zone during in-water work, in-water work will not significantly affect the distribution or abundance of prey species in the action area.
- Any dredge sediments in the project footprint that do not meet DMMP standards will be disposed of at an approved upland location.
- Minimization measures described in WSF BAR Section 2.3 (2.3.1, 2.3.2, and 2.3.3) will be implemented to minimize potential impacts to marbled murrelet and prey species.

The project will also result in several beneficial effects to marbled murrelet prey species:

- The project will reduce overwater cover by more than three acres.
- The project will result in an increase of about 2,886 ft^2 of benthic habitat.
- The project will remove over 7,300 tons of creosote-treated timber from the aquatic environment.

Puget Sound ESU Chinook salmon (Oncorhynchus tshawytscha), Puget Sound DPS Steelhead (O. mykiss) and Coastal-Puget Sound DPS Bull trout (Salvelinus confluentus)

Salmonid presence near the ferry terminal and species biology is described in the following WSF BAR sections:

- Puget Sound Evolutionarily Significant Unit (ESU) Chinook salmon – Section 4.12.2.1 (p. 353) and Appendix B (p B1).
- Puget Sound DPS Steelhead – Section 4.12.2.3 (p. 356) and Appendix B (p B4).
- Coastal-Puget Sound bull trout – Section 4.12.2.8 (p. 360) and Appendix B (p B28).

The Snohomish River is approximately seven miles north of the project area and supports runs of Chinook, steelhead, and bull trout. Juvenile Chinook have been documented along the Mukilteo shoreline from April through July and move to deeper waters in August and September. Very few steelhead were captured during beach seining efforts in central Puget Sound (only nine out of 34,000 salmonids); all were caught between May and August. Subadult and adult bull trout enter the Snohomish estuary and marine nearshore between April and until approximately mid-August. Only two bull trout have been documented in the Mukilteo area.

Effects Analysis

Direct effects on salmonids from this project will occur from in-water noise due to impact pile driving (WSF BAR p. 83), creation of new overwater cover (WSF BAR p. 96), temporary increases in turbidity from pile installation and removal, installation of stone columns, and dredging (WSF BAR p. 93), potential mobilization of contaminated sediments (WSF BAR p. 102), and increased pollutant loads in stormwater discharge. These species will also benefit from a net reduction of overwater cover, removal of a large barrier to nearshore migration (the Tank Farm pier), increase in benthic habitat, and removal of creosote-treated timber. An analysis of direct effects on salmonids is described in the WSF BAR Section 3.1 (p. 83). Indirect effects include potential effects on prey species.

Underwater Noise

Impact pile driving will create noise levels of 184 dB_{PEAK} (170 dB_{RMS}). Approximately 300 pile strikes will be required for each pile. About five piles will be installed per day, for a total of 1,500 estimated number of pile strikes per day, generating 191 dB_{SEL} (Appendix D).

NMFS and USFWS have set an injury threshold for fish of 206dB$_{PEAK}$, and 187 dB$_{SEL}$ for fish ≥2 grams and 183 dB$_{SEL}$ for fish <2 grams. Impact pile driving will not exceed the injury threshold, but will exceed the 183 dB$_{SEL}$ and 187 dB$_{SEL}$ thresholds. Noise will attenuate to 187 dB$_{SEL}$ within 59 ft of the source; any fish greater than two grams within that zone could be injured during impact pile driving. Noise will attenuate to 183 dB$_{SEL}$ approximately 108 ft from the source (Figure 18). Any fish less than two grams within that area could be injured due to impact pile driving.

Overwater Cover

Overwater cover along the shoreline can disrupt juvenile salmonid migration, leading to higher energy expenditure (WSF BAR p. 97). The project will construct a ferry terminal and fishing pier totaling approximately 15,187 ft^2 along the Mukilteo shoreline, which could pose a barrier to nearshore migration. However, the project will also remove the existing terminal, fishing pier, and the Tank Farm pier for a net reduction of overwater cover of about 129,409 ft^2 (2.97 ac) within the project area. The new trestle will be approximately 100 feet long, compared to the over 1,500-ft long Tank Farm pier, with far fewer piles, and will be a much smaller barrier to nearshore migration of juvenile salmonids than the Tank Farm pier.

Stormwater discharge

New PGIS totals 10.2 acres. The project will provide enhanced stormwater treatment for all new PGIS, but will still increase pollutant loading to Possession Sound and result in a larger dilution plume for DZn. Any salmonids that are in the nearshore during stormwater discharges could be exposed to a greater extent of higher pollutant concentrations and avoid the area, potentially interfering with migration and/or foraging. However, stormwater discharges are more likely in the winter months, when juvenile salmonids are less likely to be present, though some juvenile bull trout may enter saltwater as early as mid-February.

Potential Effects to Prey

Puget Sound Chinook feed primarily on forage fish (WSF BAR p. B-1). Steelhead eat fish, squid, and amphipods (WSF BAR p. B-4), and bull trout in the marine environment feed almost exclusively on other fish (WSF BAR p. B-28). All of these prey species could be found near the terminal, and sand lance (a forage fish) spawning occurs in the immediate vicinity of the terminal (Figure 12). Potential effects on prey species are the same as those on salmonids: in-water noise due to impact pile driving, temporary increases in turbidity, mobilization of contaminated sediments, and increased pollutant loading in stormwater. Beneficial effects to prey species as a result of project construction are a reduction of overwater cover, increase in benthic habitat, and removal of creosote-treated timber,

Figure 18. Injury threshold zones for fish from noise generated by impact pile driving.

0 0.01 0.02 0.04 Miles

N

Trestle footprint

Injury zone for fish >2g

Injury zone for fish <2g

Washington State Department of Transportation

Effect Determination

A **may affect** determination is warranted for Puget Sound ESU Chinook salmon, Puget Sound DPS steelhead and Coastal-Puget Sound DPS bull trout because:

- Chinook salmon, steelhead and bull trout may be present in the action area during in-water work.
- Impact pile driving will generate noise levels above the injury threshold for listed salmonids
- The new terminal could disrupt migration of juvenile salmonids along the shoreline.
- Dredging, installation of stone columns, and pile removal will generate elevated turbidity levels.

The project is **likely to adversely affect** Puget Sound ESU Chinook salmon, Puget Sound DPS steelhead, and Coastal-Puget Sound bull trout because:

- Pile driving will produce sound pressure levels high enough to injure fish. Fish ≤2 grams could be injured within 108 feet of impact pile driving, and fish >2 grams could be injured within 59 feet of impact pile driving.
- Creation of additional PGIS will increase pollutant loading.

Construction activities will disturb contaminated sediments in the project area. The potential for impacts to listed salmonids and their prey is reduced by the following factors:

- In-water construction will be limited to the in-water work window timeframe when salmonids, particularly juvenile salmonids, are least likely to be present.
- Impact pile driving will only last 68 hours over two weeks.
- Though a low number of salmonid prey species individuals may be affected within the immediate work zone during in-water work, the project is not expected to significantly affect the distribution or abundance of prey species in the action area.
- Any dredged material that does not meet DMMP standards will be disposed of at an approved upland location.
- The project will provide enhanced stormwater treatment to minimize pollutants discharged to Possession Sound.
- Minimization measures described in WSF BAR Section 2.3 (2.3.1, 2.3.2, and 2.3.3) will be implemented to minimize potential impacts to salmonids and prey species.

The project will also result in several beneficial effects to listed salmonids and their prey:

- The project will reduce overwater cover by more than three acres.
- Removal of the Tank Farm pier will eliminate a large barrier to nearshore migration.
- The project will result in an increase of about 2,886 ft^2 of benthic habitat.
- The project will remove over 7,300 tons of creosote-treated timber from the aquatic environment.

Puget Sound Chinook Salmon Critical Habitat

Puget Sound ESU Chinook salmon critical habitat Primary Constituent Elements (PCEs) provided in the ferry terminal area, and their existing conditions are listed in the WSF BAR Table MU-1 (p.355). The following PCEs for Chinook salmon critical habitat are present in the action area:

- PCE #5: Nearshore marine areas free of obstruction with water quality and quantity conditions and forage including aquatic invertebrates and fishes supporting growth and maturation; and natural cover, such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders and side channels.
- PCE# 6: Offshore areas with water quality conditions and forage including aquatic invertebrates and fishes, supporting growth and maturation.

Effects Analysis

In the short term the project will generate turbidity and cause impacts to benthic habitat that could reduce water quality and forage conditions. In the long-term the project will reduce the amount of overwater cover and number of in-water piles, increasing available benthic habitat. Sediments in the project footprint may be contaminated; however, the project will be designed to minimize disturbing contaminated sediments to the extent possible. BMPs will be implemented to properly handle any potentially contaminated sediments. Any dredged materials that do not meet DMMP standard will be disposed of at existing upland facilities permitted to accept contaminated waste. Transport of contaminated material will use existing haul routes, such as state highways. The contractor will provide bills of lading to WSDOT to ensure that contaminated materials have been disposed of properly.

The project will remove over 4,000 creosote-treated piles, reducing the potential for PAHs to be released into the environment. The project will also provide enhanced stormwater treatment, minimizing pollutant loads in stormwater discharged to Possession Sound. However, loads of DCu will likely increase due to the creation of additional PGIS.

Effect Determination

A **may affect** determination is warranted for Puget Sound ESU Chinook salmon critical habitat because:

- The project is within designated Puget Sound Chinook ESU salmon critical habitat.

The project is **likely to adversely affect** designated Puget Sound ESU Chinook salmon critical habitat because:

- Impact pile driving could disrupt nearshore migration.
- The new terminal and fishing pier may disrupt nearshore migration.

- Temporary increases in turbidity from dredging, stone column installation, and pile removal will occur.
- Construction activities will disturb contaminated sediments in the project area.
- Stormwater runoff from PGIS post-project will contain levels of contaminants above pre-project levels.

The potential for impacts to Chinook critical habitat is reduced by the following factors:

- Though a low number of salmonid prey species individuals may be affected within the immediate work zone during in-water work, the project is not expected to significantly affect the distribution or abundance of salmonid prey species in the action area.
- Impact pile driving will only last 68 hours over two weeks.
- The project will be designed to minimize disturbing contaminated sediments; any dredged material in the project footprint that does not meet DMMP standards will be disposed of at an approved upland location.
- The project will provide enhanced stormwater treatment to minimize pollutant loading in stormwater discharged to Possession Sound.

The project will result in the following beneficial effects to critical habitat:

- The project will reduce overwater cover by more than three acres.
- Removal of the Tank Farm pier will eliminate a large barrier to nearshore migration.
- The project will result in an increase of about 2,886 ft^2 of benthic habitat.
- The project will remove over 7,300 tons of creosote-treated timber from the aquatic environment.

Coastal-Puget Sound Bull Trout Critical Habitat

Coastal-Puget Sound DPS bull trout critical habitat PCEs at the Mukilteo ferry terminal and their existing conditions are listed in Table MU-3 of the WSF BAR (p. 361). The following PCEs are present in the action area:

- PCE #1: Water temperatures ranging between 2° to 15°C (39° to 59°F) with adequate thermal refugia available for temperatures at the upper end of the range
- PCE #6: Migratory habitat with minimal physical, biological, or water quality impediments
- PCE #7: Abundant food base including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.
- PCE #8: Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

Effects Analysis

The project will not affect water temperatures in the action area. Migratory habitat will be improved by the removal of overwater cover and in-water piles; however, noise from impact pile driving could be a temporary impediment to movement along the nearshore. There may be a temporary decrease in forage fish and water quality due to impacts from pile removal and installation, stone column construction, and dredging, but impacts will be temporary. The project will provide enhanced stormwater treatment for stormwater runoff in the project area. However, pollutant loads will likely increase due to the creation of additional PGIS.

Effect Determination

The project **may affect** Coastal-Puget Sound DPS bull trout critical habitat because:

- The project is within designated bull trout critical habitat.

The project is **likely to adversely affect** designated Coastal-Puget Sound DPS bull trout critical habitat because:

- Impact pile driving could disrupt nearshore migration.
- Temporary increases in turbidity from dredging, stone column installation, and pile removal will occur.
- Construction activities could disturb contaminated sediments in the project area.
- Stormwater runoff from PGIS post-project may contain levels of contaminants above pre-project levels.

The potential for impacts to bull trout critical habitat is reduced by the following factors:

- Though a low number of salmonid prey species individuals may be affected within the immediate work zone during in-water work, the project is not expected to significantly affect the distribution or abundance of bull trout prey species in the action area.
- Impact pile driving will only last 68 hours over two weeks.
-
- Any dredged material in the project footprint that does not meet DMMP standards will be disposed of at an approved upland location.

The project will result in the following beneficial effects to critical habitat:

- The project will reduce overwater cover by more than three acres.
- Removal of the Tank Farm pier will eliminate a large barrier to nearshore migration.
- The project will result in an increase of about 2,886 ft^2 of benthic habitat.
- The project will remove over 7,300 tons of creosote-treated timber from the aquatic environment.

Georgia Basin DPS Bocaccio Rockfish (Sebastes paucispinis), Canary Rockfish (Sebastes pinniger) and Yelloweye Rockfish (Sebastes ruberrimus)

Rockfish presence near the ferry terminal is described in the WSF BAR Section 4.12.2.14 (p. 363). Yelloweye and canary rockfish have been observed in Saratoga Passage off the Mukilteo shoreline, and a bocaccio was caught in Port Garner Bay near Everett (Miller and Borton 1980).

The vicinity of the existing and proposed ferry terminal locations does not provide ideal habitat for adult rockfish, which prefer deeper waters with rocky substrate. Any rockfish in the vicinity of the existing and proposed ferry terminal locations are likely pelagic larvae or possibly juveniles. Parturition peaks in February for bocaccio, December and January for canary rockfish, and May – June for yelloweye rockfish. Although there is some potential for in-water construction to overlap with the presence of larval or juvenile rockfish (particularly canary rockfish), in-water work will occur from July-February when larval and juvenile rockfish are less likely to be present in the action area.

Effects Analysis

Direct effects on rockfish from this project will occur from in-water noise due to impact pile driving, increases in turbidity, the potential for mobilization of contaminated sediments, and an increase of pollutants in stormwater discharge. Analysis of direct effects on rockfish is described in the WSF BAR, Section 3.6 (p. 114). Indirect effects include potential effects on prey species. Both rockfish and their prey species will benefit from a reduction of overwater cover, increase in benthic habitat, and removal of creosote-treated timber.

Noise thresholds for rockfish are the same as those established for salmonids, described above. Fish greater than two grams could be injured if they are within 59 ft of the pile driving source; fish less than two grams could be injured if they are within 108 ft from the source (Figure 18).

Turbidity will be generated during pile removal, installation of stone columns, and dredging. Turbidity and the spread of contaminated sediments will be minimized by implementing appropriate BMPs and minimization measures as described in the WSF BAR Section 2.3 and in this BA. Additional testing of sediments within the project footprint will occur prior to construction. Any dredged materials that do not meet DMMP standards will be disposed of at existing upland facilities permitted to accept contaminated waste.

Rockfish foraging is described in the WSF BAR Appendix B: bocaccio (p.B-19), yelloweye rockfish (p. B-22) and canary rockfish (p. B-25). Larval and juveniles of all species eat krill, plankton, eggs of fish and other aquatic organisms, and other small prey. Potential effects on prey species are temporary increases in turbidity, mobilization of contaminated sediments, and benthic habitat impacts. Turbidity and mobilization of contaminated sediments will be minimized by implementation of appropriate BMPs. Construction of the

new terminal will have about 341 ft^2 of benthic habitat impacts; however, demolition of the existing terminal and the Tank Farm pier will remove about 4,000 piles, increasing available habitat by about 2,886 ft^2.

Effect Determination

A **may affect** determination is warranted for Georgia Basin DPS bocaccio rockfish, canary rockfish and yelloweye rockfish because:

- Listed rockfish may be present in the action area during in-water work.
- Pile driving will produce sound pressure levels high enough to injure fish.
- Dredging, stone column installation, and pile removal will generate elevated turbidity levels.
- Construction activities could disturb contaminated sediments in the project area.
- Stormwater runoff from PGIS post-project may contain levels of contaminants above pre-project levels.

The project is **not likely to adversely affect** Georgia Basin DPS bocaccio rockfish, canary rockfish and yelloweye rockfish because:

- In-water construction will be limited to the in-water work window when larval and juvenile rockfish are least likely to be present in the nearshore.
- It is unlikely that Georgia Basin DPS bocaccio, canary and yelloweye rockfish juveniles or pelagic larvae will be present within the injury zone (Figure 18) during impact pile driving.
- It is unlikely that rockfish adults will be present near the project footprint due to the lack of suitable habitat.
- Impact pile driving will only last 68 hours over two weeks.
- Any dredged material in the project footprint that does not meet DMMP standards will be disposed of at an approved upland location.
- The project will provide enhanced stormwater treatment to minimize pollutants discharged to Possession Sound.
- Though a low number of rockfish prey species individuals may be affected within the immediate work zone during in-water work, the project is not expected to significantly affect the distribution or abundance of potential rockfish prey species in the action area.
- Minimization measures described in WSF BAR Section 2.3 (2.3.1, 2.3.2, and 2.3.3) will be implemented to minimize potential impacts to Georgia Basin DPS bocaccio rockfish, canary rockfish, yelloweye rockfish and their prey species.

The project will result in the following beneficial effects to rockfish and their prey species:

- The project will reduce overwater cover by more than three acres.
- The project will result in an increase of about 2,886 ft^2 of benthic habitat.

- The project will remove over 7,300 tons of creosote-treated timber from the aquatic environment.

Southern DPS Eulachon/Columbia River Smelt (Thaleichthys pacificus)

Eulachon presence near the ferry terminal is described in the WSF BAR Section 4.12.2.15 (p. 364). There are no spawning rivers near the terminal, and no records of any eulachon near the terminal. Any eulachon found in the action area would likely be adults.

Effects Analysis

As with other fish species, direct effects to eulachon from this project will occur from in-water noise due to impact pile driving, increases in turbidity, the potential for mobilization of contaminated sediments, and an increase of pollutants in stormwater discharge. Analysis of effects on eulachon is described in the WSF BAR, Section 3.7 (p. 115). Indirect effects include potential effects on prey species. Both eulachon and their prey species will benefit from a reduction of overwater cover, increase in benthic habitat, and removal of creosote-treated timber.

Noise thresholds for eulachon are also the same as those established for salmonids described above. Fish greater than two grams could be injured if they are within 59 ft of the pile driving source; fish less than two grams could be injured if they are within 108 ft from the source (Figure 18).

Turbidity and the spread of contaminated sediments will be minimized by implementing appropriate BMPs and minimization measures as described in the WSF BAR Section 2.3 and in this BA. Additional testing of sediments within the project footprint will occur prior to construction. Any dredged materials that do not meet DMMP standards will be disposed of at existing upland facilities permitted to accept contaminated waste.

Eulachon feed primarily on zooplankton (WSF BAR p. B-19). Potential effects on prey species are temporary increases in turbidity, benthic habitat impacts, and mobilization of contaminated sediments.

Effect Determination

A **may affect** determination is warranted for Southern DPS eulachon because:

- Southern DPS eulachon may be present in the action area.
- Pile driving will produce sound pressure levels high enough to injure fish.
- Dredging and pile removal will generate elevated turbidity levels.
- Construction activities could disturb contaminated sediments in the project area.
- Stormwater runoff from PGIS post-project may contain levels of contaminants above pre-project levels.

The project is **not likely to adversely affect** Southern DPS eulachon because:

- It is unlikely that Southern DPS eulachon/Columbia River smelt will be present in the action area, given that their presence in Puget Sound/Georgia Basin is rare.
- Impact pile driving will only last 68 hours over two weeks.
- Though a low number of eulachon prey species individuals may be affected within the immediate work zone during in-water work, the project is not expected to significantly affect the distribution or abundance of prey species in the action area.
- The project will be designed to minimize disturbing contaminated sediments; any dredged material in the project footprint that does not meet DMMP standards will be disposed of at an approved upland location.
- The project will provide enhanced stormwater treatment to minimize pollutants discharged to Possession Sound.
- Minimization measures described in WSF BAR Section 2.3 (2.3.1, 2.3.2, and 2.3.3) will be implemented to minimize potential impacts to eulachon and prey species.

The project will result in the following beneficial effects to eulachon and their prey species:

- The project will reduce overwater cover by more than three acres.
- The project will result in an increase of about 2,886 ft^2 of benthic habitat.
- The project will remove over 7,300 tons of creosote-treated timber from the aquatic environment.

Southern DPS North American Green Sturgeon (Acipenser medirostris)

Green sturgeon presence near the Mukilteo Ferry Terminal is discussed in Section 4.1.2.10 of the WSF BAR (p. 362). There are no natal streams near the action area, and only two Southern DPS green sturgeon have been observed in Puget Sound. Foraging adults could be present in the action area.

Effects Analysis

Direct effects to green sturgeon from this project will occur from in-water noise due to impact pile driving, the potential for mobilization of contaminated sediments, and an increase of pollutants in stormwater discharge. Analysis of effects on sturgeon is described in the WSF BAR, Section 3.1 of the WSF BAR (p. 83). Indirect effects include potential effects on prey species. Both sturgeon and their prey species will benefit from a reduction of overwater cover, increase in benthic habitat, and removal of creosote-treated timber.

Noise thresholds for green sturgeon are also the same as those established for salmonids described above. Fish greater than two grams could be injured if they are within 59 ft of the pile driving source (Figure 18). Only adult and subadult sturgeon would be found in the action area, so fish less than two grams would not be exposed to elevated sound pressure levels.

Green sturgeon feed on shrimp, mollusks, amphipods, and small fish, which are all found in the action area (WSF BAR p. B-15). Potential effects on prey species include in-water noise due to pile driving, temporary increases in turbidity, mobilization of contaminated

sediments, and increased pollutant loading in stormwater discharged from PGIS in the project area.

Effect Determination

A **may affect** determination is warranted for Southern DPS North American green sturgeon because:

- Southern DPS North American green sturgeon may be present in the action area.
- Pile driving will produce sound pressure levels high enough to injure fish.
- Dredging and pile removal will generate elevated turbidity levels.
- Construction activities could disturb contaminated sediments in the project area.
- Stormwater runoff from PGIS post-project may contain levels of contaminants above pre-project levels.

The project is **not likely to adversely affect** Southern DPS North American green sturgeon because:

- It is highly unlikely that Southern DPS North American green sturgeon will be present in the action area, given that their presence in Puget Sound/Georgia Basin is rare.
- Impact pile driving will only last 68 hours over two weeks.
- Though a low number of green sturgeon prey species individuals may be affected within the immediate work zone during in-water work, the project is not expected to significantly affect the distribution or abundance of prey species in the action area.
- Any dredged material in the project footprint that does not meet DMMP standards will be disposed of at an approved upland location.
- The project will provide enhanced stormwater treatment to minimize pollutants discharged to Possession Sound.
- Minimization measures described in WSF BAR Section 2.3 (2.3.1, 2.3.2, and 2.3.3) will be implemented to minimize potential impacts to Southern DPS North American green sturgeon and prey species.

The project will result in the following beneficial effects to critical habitat:

- The project will reduce overwater cover by more than three acres.
- The project will result in an increase of about 2,886 ft^2 of benthic habitat.
- The project will remove over 7,300 tons of creosote-treated timber from the aquatic environment.

Indirect effects

Indirect effects are those that are caused by or resulting from the proposed action and are later in time but still reasonably certain to occur (50 CFR 402.02). Indirect effects fall into three general categories:

a. Changes to ecological systems resulting in altered predator/prey relationships
b. Changes to ecological systems resulting in long-term habitat alteration
c. Anticipated changes in human activities, including changes in land use

Changes to ecological systems are discussed for each individual species, above. Potential effects due to changes in land use are described below.

WSDOT has developed a guidance document for assessing the indirect effects between transportation and land use development (WSDOT 2012). The document describes a step-by-step approach to assess indirect effects by asking a series of questions about potential land use changes brought about by the project. The relevant steps are listed below:

Step 1: Will the project create a new facility (e.g., new road, new interchange etc.)? If yes, go to step 3.

The project does create a new facility by relocating an existing terminal.

Step 3. Determine if the transportation project has a causal relationship to a land use change by answering the following questions:

a. *Is there a building moratorium in place that is contingent on the proposed road improvements?*

   There is no building moratorium in place that is contingent on the project (McCartney, pers. comm.5/22/12).

b. *Are there any land use changes tied by permit condition to the proposed project?*

   There are no land use changes tied by permit condition to the proposed project (McCartney, pers. comm. 5/22/12).

c. *Do the project's NEPA documents identify other actions or land use changes caused by or resulting from the project that are reasonably certain to occur?*

   The project's NEPA documents do not identify any action or land use changes caused by or resulting from the project.

d. *Do development plans include scenarios for the planning area where land use differs based on a "build" and "no build" outcome related to the proposed project?*

   If the proposed project moves forward, the existing holding lanes in downtown Mukilteo will be redeveloped. The holding lanes do not provide habitat for any listed species and impacts of redevelopment are not likely to extend to habitat for listed species.

Portions of the Tank Farm property not occupied by the new terminal will likely be redeveloped at some point in the future. Redevelopment of the property may present some opportunities for softening of the shoreline and shoreline restoration. However, there are no reasonably foreseeable plans at this time as to how the property will be redeveloped.

e. *Is there land use change that is likely to occur at a different rate as a result of the project?*

The population of Snohomish County has grown from about 265,000 in 1970 to over 713,000 today and is scheduled to increase to between 826,000 and 1.2 million by 2040 (OFM 2012). This growth and associated land development is independent of the proposed project. There is no mention of the proposed project in the Snohomish County Comprehensive Plan (Snohomish County 2012). The project is discussed in the City of Mukilteo Comprehensive Plan (City of Mukilteo 2012) but according to planners at the city there are no permits or building moratoria tied to the proposed project (McCartney, pers. comm. 5/22/12). Therefore there are no land use changes that are likely to occur at a different rate as a result of the project.

Step 4. Recheck the size of the action area.

The proposed project is not likely to result in any induced growth. Therefore, the action area defined above is appropriate.

Cumulative Effects

Cumulative effects are those effects of future state, local, or private activities, not involving federal activities, that are reasonably certain to occur within the action area addressed by this BA (50 CFR 402.02). Several potential projects have been identified in the action area (Table 12). Other projects likely to occur in the action area such as plans by the City of Mukilteo to relocate their boat launch, restoration of Japanese Creek, and several Sound Transit projects will have a federal nexus and their own ESA consultation.

The action area is in a highly urbanized setting that is largely developed. Two of the projects identified here will have no effect to listed species because there is no suitable habitat for those species within the project area. The Mount Baker Terminal Access Road and City of Mukilteo Lighthouse Park Improvement projects could increase PGIS, thereby generating additional pollutants that will be discharged to Possession Sound. However, future projects will be required to comply with the relevant city and county stormwater codes, which require treatment of stormwater discharged to receiving water bodies and implementation of green stormwater infrastructure that reduces runoff from impervious surfaces.

Table 12. Non-federal projects reasonably certain to occur in the Mukilteo Multimodal Project action area and potential effects of those projects on ESA-listed species

Project	Potential cumulative effects	Project proponent
Redevelopment of holding areas The area currently occupied by ferry holding lanes would be redeveloped. Redevelopment would likely be a mix of commercial and residential units.	None: The holding lanes do not provide habitat for any listed species.	Undetermined
Port of Everett Mount Baker Terminal access road This project would complete a permanent access road to the Mount Baker Terminal.	This project would create additional PGIS, potentially increasing pollutant loading to Possession Sound. Impacts would be offset by designing the project according to appropriate city and county stormwater codes.	Port of Everett
Mount Baker Crossing This project would create an improved at-grade crossing of the BNSF railroad track connecting Mukilteo Lane to the Tank Farm.	None: The project area does not provide habitat for any listed species.	Port of Everett
City of Mukilteo Lighthouse Park Improvements Project Phase 3 of this project includes improvements to Front Street, completion of the park driveway and construction of the parking area in the southeast corner of the site.	This project would create additional PGIS, potentially increasing pollutant loading to Possession Sound. Impacts would be offset by designing the project according to appropriate city and county stormwater codes.	City of Mukilteo

6. Essential Fish Habitat (EFH) Effects Analysis

EFH in the action area is identified in Appendix D of the WSF BAR.

The impacts associated with this project:

- Noise from impact pile driving will exceed fish injury thresholds
- Temporary increases in turbidity from dredging and stone column installation will occur.
- Sediments in the project footprint may be contaminated.
- Stormwater runoff from PGIS post-project may contain levels of contaminants above pre-project levels.

Will be offset by minimization measures listed in WSF BAR Appendix D, Table D-2, and those below:

- Impact pile driving will only last 68 hours over two weeks
- The project will reduce overwater cover by more than three acres.
- The project will result in an increase of about 2,886f ft^2 of benthic habitat.
- The project will remove over 7,300 tons of creosote-treated timber from the aquatic environment.
- Any dredged material in the project footprint that does not meet DMMP standards will be disposed of at an approved upland location.
- The project will provide enhanced stormwater treatment to minimize pollutants discharged to Possession Sound.
- Minimization measures described in WSF BAR Section 2.3 (2.3.1, 2.3.2, and 2.3.3), will be implemented to minimize potential impacts to EFH and prey species.

Despite minimization measures incorporated into the project design and use of enhanced stormwater treatment BMPs, pollutants in stormwater runoff post-project will be above pre-project levels. Therefore, it is concluded that this project **will adversely affect** Pacific groundfish, coastal pelagic or Pacific salmon EFH.

7. References Cited in Addition to those listed in the WSF Reference BA

Anchor 2005. Biological Resources Survey. Prepared for Washington State Ferries Terminal Engineering Department.

Baldwin, D.H., J.F. Sandahl, J.S. Labenia, and N.L. Scholz. 2003. Sublethal effects of copper on coho salmon: impacts on non-overlapping receptor pathways in the peripheral olfactory nervous system. Environmental Toxicology and Chemistry 22: 2266-2274

City of Mukilteo 2012. City of Mukilteo Comprehensive Plan. Available online at http://www.ci.mukilteo.wa.us/page.asp?navid=57

Coast & Harbor Engineering 2012a. Elliot Point 2, Mukilteo Ferry Terminal Pile Removal, Dredging, and Stone Column Installation – Temporary Effects on Water Quality. Draft Technical Memorandum. 16 pp.

Coast & Harbor Engineering. 2012b. Hydrodynamic and Sediment Transport Modeling Study – Mukilteo Ferry Terminal. 92 pp.

Confluence Environmental. 2011. Mukilteo Multimodal Project Eelgrass Survey Report. Prepared for the Washington State Department of Transportation. November 22, 2011. 87 pp.

Curl, Jr., H.C., E.T. Baker, T.S. Bates, G.A. Cannon, R.A. Feely, T.L. Geiselman, M.F. Lamb, P.P. Murphy, D.J. Pashinski, A.J. Paulson, and D.A. Tennant. 1988. Contaminant transport from Elliott Bay and Commencement Bay. National Oceanic and Atmospheric Administration (NOAA).

Ecology, Department of. 2010. Water Quality Assessment for Washington. Accessed March 20, 2012. https://fortress.wa.gov/ecy/wqamapviewer/default.aspx?res=1280x1024

Eisler, R. 1990. Chlordane Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S. Fish and Wildlife Service Patuxent Wildlife Research Center. Laurel, Maryland 20708.

Laughlin, J. 2007. Underwater sound levels associated with driving steel and concrete piles near the Mukilteo Ferry Terminal. Prepared by Washington State Department of Transportation, Office of Air Quality and Noise, Seattle, WA. March 2007.

Laughlin, J. 2011a. Personal communication to Rick Huey (WSDOT/WSF) on June 14, 2011.

Laughlin, J. 2011b. Port Townsend Dolphin Timber Pile Removal – Vibratory Pile Monitoring Technical Memorandum. Prepared by Washington State Department of Transportation, Office of Air Quality and Noise, Seattle, Washington. January 2011.

Laughlin, J. 2012. Personal communication from Jim Laughlin (WSDOT) to George Ritchotte (WSDOT) on March 19, 2012.

McCartney, Heather. Personal communication to George Ritchotte on May 22, 2012.

McCartney, Heather. Personal communication to George Ritchotte on July 9, 2012.

Miller, B. S. and S.F Borton. 1980. Geographical Distribution of Puget Sound Fishes: maps and data source sheets. Volume 2. University of Washington, Seattle, WA. 221 pp.

NMFS 2008. Recovery Plan for Southern Resident Killer Whales (Orcinus orca). National Marine Fisheries Service, Northwest Region, Seattle, Washington. 251 pp.

NMFS. 2010. National Marine Fisheries Service. Office of Protected Resources. Marine Mammal consultation tools web page. Accessed by George Ritchotte, WSDOT on March 15, 2012. http://www.nwr.noaa.gov/Marine-Mammals/upload/MM-KW-map.pdf

NMFS. 2012. Endangered species listings website. Accessed by George Ritchotte on May 21, 2012. http://www.nwr.noaa.gov/nwrcms2/

NOAA. 2003. NOAA Screening Quick Reference Tables. NOAA Hazmat Report 99-1. Coastal Protection and Restoration Division, National Oceanic and Atmospheric Administration, Seattle, WA. 12pp.

OFM 2012. Washington State Office of Financial Management. Washington State Growth Management Population Projections for Counties. http://www.ofm.wa.gov/pop/gma/projections12/projections12.asp

Orca Network. 2012. Sightings archives. Accessed by George Ritchotte, WSDOT. May 16, 2012. http://www.orcanetwork.org/sightings/archives.html

Snohomish County 2012. Snohomish County Comprehensive Plan. Available online at http://www1.co.snohomish.wa.us/Departments/PDS/Divisions/PlanningandTechnology/LR_Planning/Projects_Programs/Comprehensive_Plan/General_Policy_Plan.htm

Sommers. 2012. Behavioral response of juvenile Chinook salmon (*Oncorhynchus tshawytscha*) to combinations of dissolved copper and submerged structure in freshwater and seawater. Master's Thesis, Evergreen State College.

Sprague, J.P. 1968. Avoidance reactions of rainbow trout to zinc sulphate solutions. Water Research 2: 367-372.

USACE 2012. Seattle District Dredged Material Management Office reports homepage. http://www.nws.usace.army.mil/Missions/CivilWorks/Dredging/Reports.aspx.

USFWS. 2012. County species listing accessed by George Ritchotte on May 21, 2012. http://www.fws.gov/wafwo/speciesmap/skagit.HTML

WDFW. 2004. Forage fish spawning beaches maps. Accessed May 16, 2012.

WDFW. 2012. 2012 Pre-season Run Forecasts. http://wdfw.wa.gov/fish/northfalcon/ . Accessed by George Ritchotte, WSDOT May 21, 2012.

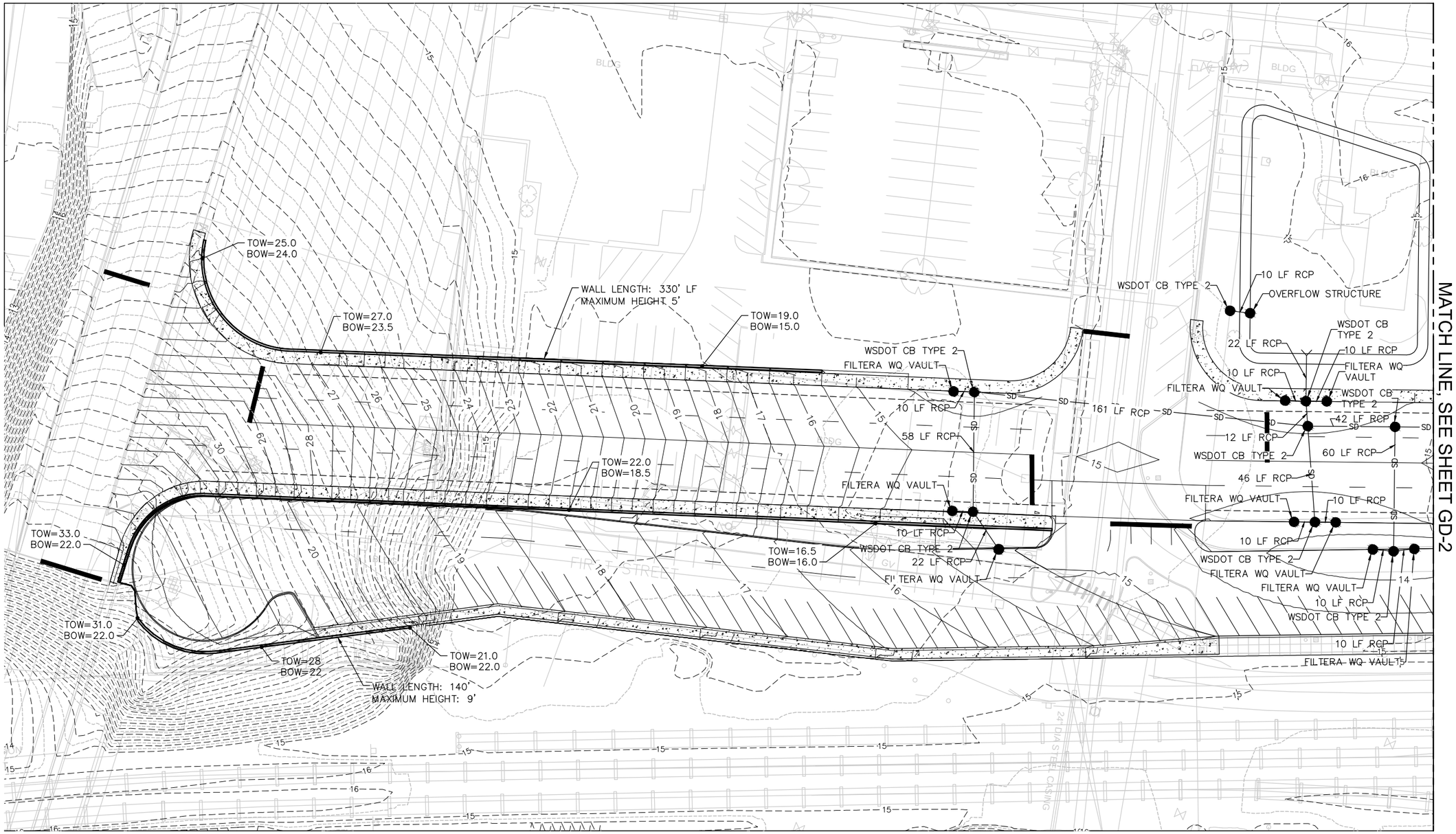
Weston Solutions and Pascoe Environmental Consulting. 2006. Jimmycomelately Piling Removal Monitoring Project. Final Report. March 2006. 109 pp.

WSDOT 2008. Highway Runoff Dilution and Loading Model User's Guide. Available online at http://www.wsdot.wa.gov/NR/rdonlyres/85B43C71-DEBE-478C-A468-C6BF64D86B64/0/BA_HighwayRunoffUsersGuide.pdf.

WSDOT. 2010. Airborne Noise Measurements (A-weighted and un-weighted) during Vibratory Pile Installation - Technical Memorandum. Jim Laughlin. Washington State Department of Transportation Office of Air Quality and Noise. June 21, 2010. Seattle, WA.

WSDOT. 2012. Biological Assessment Preparation for Transportation Projects. Advanced Training Manual - Version 02-2012. February 2012.

Appendix A. Stormwater and Grading Plan Sheets



LEGEND

TOW	TOP OF WALL
BOW	BOTTOM OF WALL
--15--	EXISTING MAJOR CONTOUR LINE
	EXISTING MINOR CONTOUR LINE
—20—	PROPOSED MAJOR CONTOUR LINE
	PROPOSED MINOR CONTOUR LINE

1" = 50' scale 25 0 25 50 feet

PRELIMINARY - NOT FOR CONSTRUCTION

MARK	REVISION DESCRIPTION	BY	APP.	DATE

BergerABAM
33301 9th Avenue South, Suite 300
Federal Way, Washington 98003-2600
(206) 431-2300 Fax: (206) 431-2250

Washington State Department of Transportation
WASHINGTON STATE FERRIES

DRAWN BY BEE
DESIGN BY
CHECK BY
PROJ MGR MGW

WASHINGTON STATE FERRIES
MUKILTEO FERRY TERMINAL
ELLIOT POINT OPTION 2
PRELIMINARY SITE PLAN EXHIBIT - SHEET 1

DRAWING NO. GD-1
PROJECT NO. FAWAT-07-859
DATE: 7/6/12
SHEET NO. 1 OF 13

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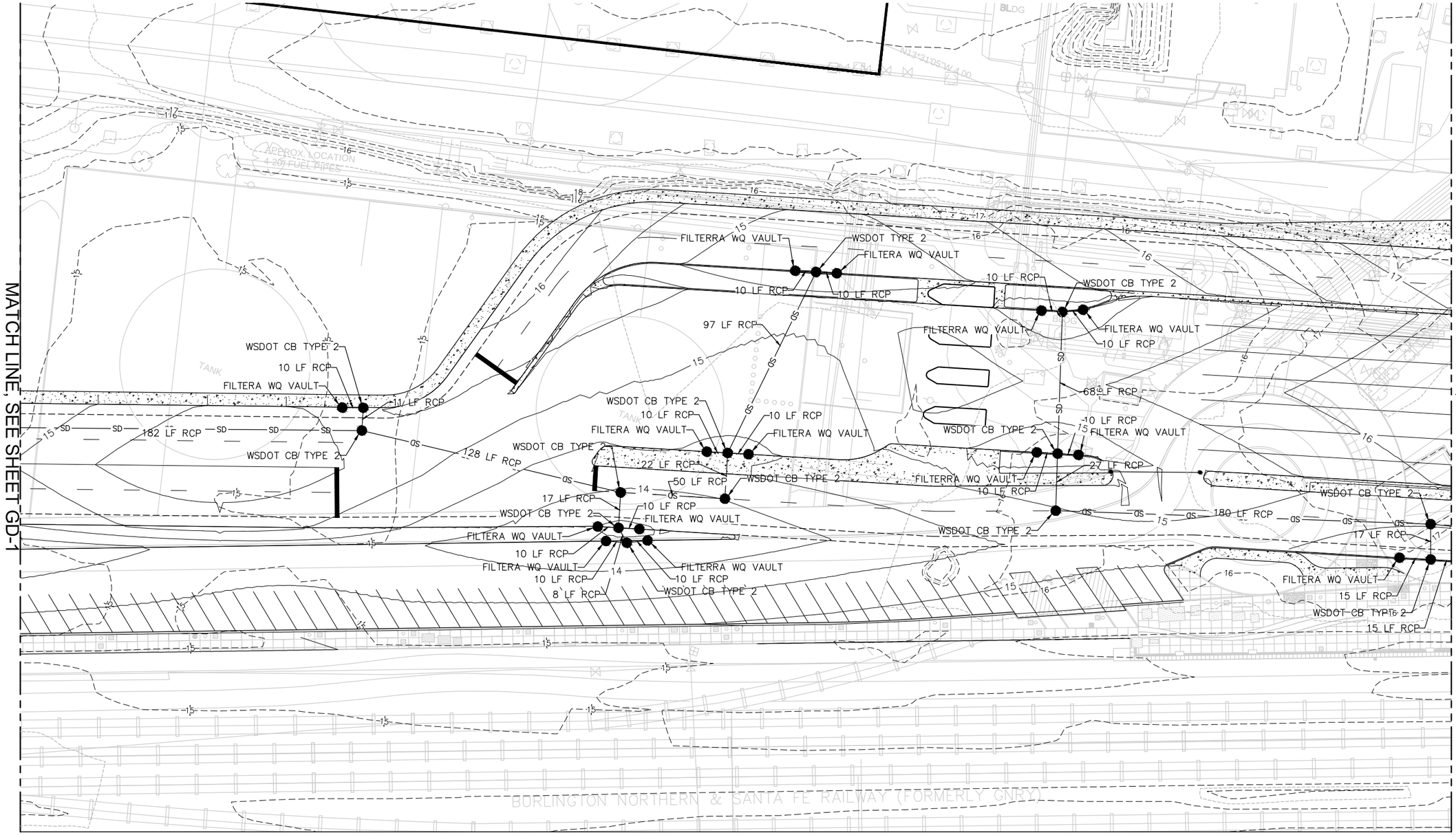

LEGEND

- 15 — EXISTING MAJOR CONTOUR LINE
- EXISTING MINOR CONTOUR LINE
- 20 — PROPOSED MAJOR CONTOUR LINE
- PROPOSED MINOR CONTOUR LINE

1" = 50' scale (25 0 25 50 feet)

PRELIMINARY - NOT FOR CONSTRUCTION

MARK	REVISION DESCRIPTION	BY	APP.	DATE

BergerABAM
33301 9th Avenue South, Suite 300
Federal Way, Washington 98003-2600
(206) 431-2300 Fax: (206) 431-2250

Washington State Department of Transportation
WASHINGTON STATE FERRIES

DRAWN BY BEE
DESIGN BY
CHECK BY
PROJ MGR MGW

WASHINGTON STATE FERRIES
MUKILTEO FERRY TERMINAL
ELLIOT POINT OPTION 2
PRELIMINARY SITE PLAN EXHIBIT - SHEET 2

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PROJECT NO. FAWAT-07-859
DATE: 7/6/12
SHEET NO. 2 OF 13

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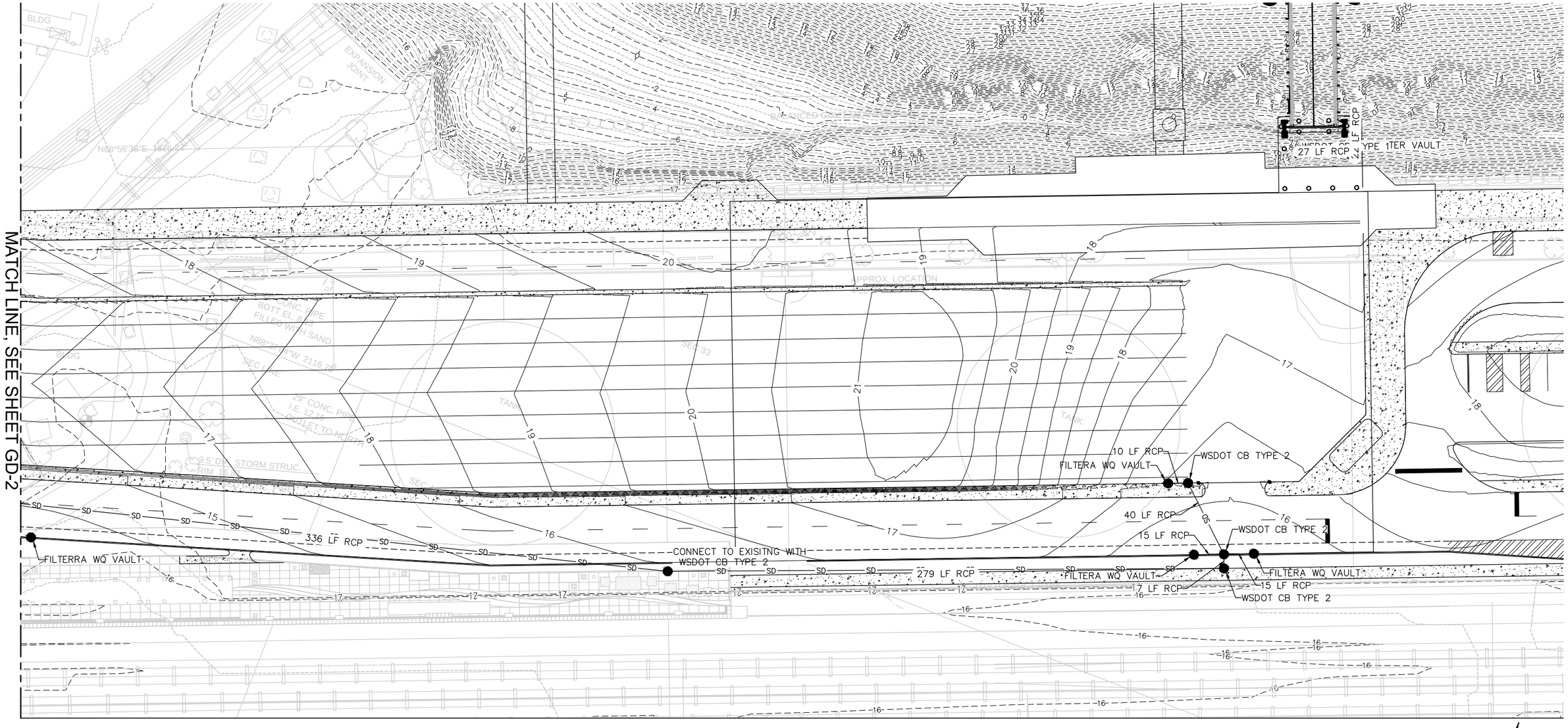
MATCH LINE, SEE SHEET GD-2



LEGEND

- EXISTING MAJOR CONTOUR LINE
- EXISTING MINOR CONTOUR LINE
- PROPOSED MAJOR CONTOUR LINE
- PROPOSED MINOR CONTOUR LINE

1" = 50' scale 25 0 25 50 feet

PRELIMINARY - NOT FOR CONSTRUCTION

MARK	REVISION DESCRIPTION	BY	APP.	DATE

BergerABAM
33301 9th Avenue South, Suite 300
Federal Way, Washington 98003-2600
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Washington State Department of Transportation
WASHINGTON STATE FERRIES

DRAWN BY BEE
DESIGN BY
CHECK BY
PROJ MGR MGW

WASHINGTON STATE FERRIES
MUKILTEO FERRY TERMINAL
ELLIOT POINT OPTION 2
PRELIMINARY SITE PLAN EXHIBIT - SHEET 3

DRAWING NO. **GD-3**
PROJECT NO. FAWAT-07-859
DATE: 7/6/12
SHEET NO. 3 OF 13

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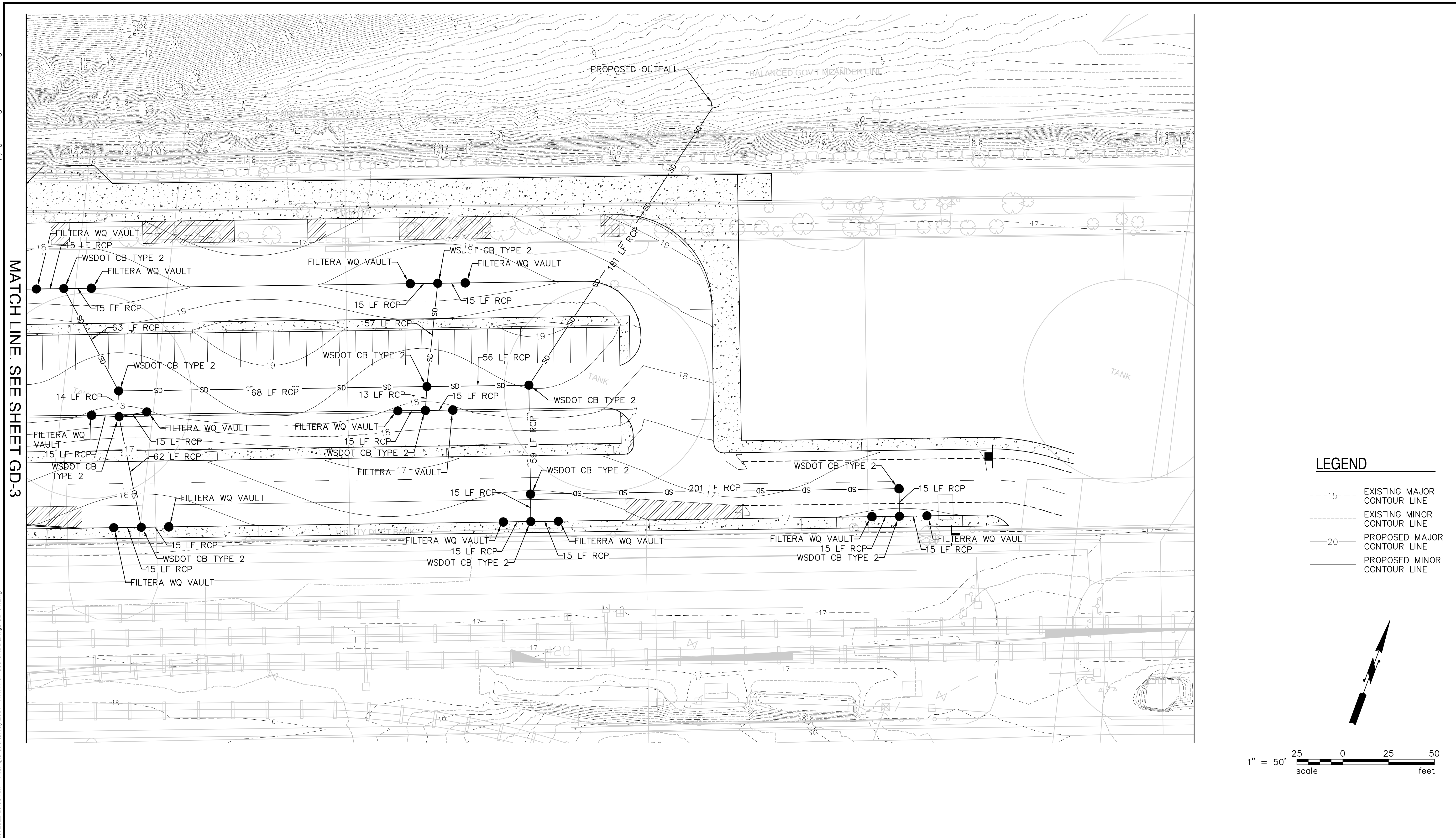

PRELIMINARY - NOT FOR CONSTRUCTION

MARK	REVISION DESCRIPTION	BY	APP.	DATE

BergerABAM
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Federal Way, Washington 98003-2600
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Washington State Department of Transportation
WASHINGTON STATE FERRIES

DRAWN BY BEE
DESIGN BY
CHECK BY
PROJ MGR MGW

WASHINGTON STATE FERRIES
MUKILTEO FERRY TERMINAL
ELLIOT POINT OPTION 2
PRELIMINARY SITE PLAN EXHIBIT - SHEET 4

DRAWING NO. **GD-4**
PROJECT NO. FAWAT-07-859
DATE: 7/6/12
SHEET NO. 4 OF 13

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Appendix B. Marbled murrelet monitoring plan

U.S. Fish and Wildlife Service – Washington Fish and Wildlife Office

Protocol for Marbled Murrelet Monitoring During Impact Pile Driving (Revised 8/13/2012)

Mukilteo Multimodal Project **October 18, 2012**

1.0 Objective

The intent of the monitoring protocol is to:
1. Comply with the requirements of the Endangered Species Act Section 7 consultation for the Washington State Department of Transportation/Ferries Division (WSF) Mukilteo Multimodal Project.
2. Detect all marbled murrelets (murrelets) within 33 meters (108 ft) of impact pile driving.
3. To avoid injury of murrelets from exposure to elevated underwater sound pressure associated with pile driving by communicating immediately with the Construction Contractor.
4. Track incidental take exempted through the Incidental Take Statement found in the final Biological Opinion for the project so that the WSF will know when take occurs and/or when take exemptions might be exceeded.

2.0 Adaptive Approach

The individuals that implement this protocol will assess its effectiveness during implementation. They will use their best professional judgment throughout implementation and will seek improvements to these methods when deemed appropriate. Any modifications to this protocol will be coordinated between the WSF and the Washington Fish and Wildlife Office.

3.0 Monitoring

3.1 Activities to be Monitored

Application of this protocol is required as specified through the Endangered Species Act consultation process for individual projects. It may apply projects that involve either in-water impact pile driving when injurious sound pressure levels are expected and to projects that involve either vibratory or impact pile driving when in-air sounds are expected to cause masking effects.

3.2 Equipment

- Binoculars - quality 8 or 10 power;
- Spotting scopes;
- Two-way radios with earpieces;
- Range finder;
- Log books;
- Seabird identification guide;
- Life vest or other personal flotation device for observers in boats;
- Cellular phone to contact WSF, the Construction Contractor, or WFWO.

3.3 Locations

Proposed monitoring locations are shown in Figure 1. Due to limitations that could result from construction activity and/or other site specific variables, the monitoring locations may be refined in the field. In that case, final monitoring locations will be noted on an aerial photo or plan sheet, and documented in the final monitoring report.

3.4 Monitoring Techniques

Only concrete piles will be driven using an impact hammer, resulting in a small monitoring zone that can be covered by a single qualified biologist (the lead biologist). The lead biologist shall be responsible for communicating with m the Construction Contractor and the WFWO.

The lead biologist will be positioned at an on-shore vantage point. The on-shore vantage point will allow for an unobstructed view of the monitoring zone at all times. Evaluations of murrelet survey effectiveness indicate there is a reasonable probability of detecting murrelets within 50 meters when the sea state is at a Beaufort scale of 2 or better. The Beaufort scale is presented in Table 1 below.

Using a scope and binoculars, the lead biologist will scan for murrelets within the monitoring zone. The biologist will sweep the monitoring zone prior to each pile driving attempt to ensure that no murrelets are in the monitoring zone. If no murrelets are within the zone, the lead biologist will communicate to the WSF Site Inspector, who will communicate to the Construction Contractor that pile driving may commence. During pile driving the lead biologist will continue scanning the area for murrelets. If murrelets are seen within the monitoring zone during pile driving, the lead biologist will communicate to the WSF Site Inspector, who will communicate to the Construction Contractor that he/she is to cease pile driving. Pile driving will not resume until the murrelets have left the 33-meter monitoring area.

Murrelets are especially vulnerable to disturbance when they are molting and flightless. Molting occurs after nesting in late summer, typically July through September in Puget Sound populations. Extra precaution should be exercised during this period.

3.5 Limitations

No monitoring will be conducted during inclement weather that creates potentially hazardous conditions as determined by the lead biologist. No monitoring will be conducted when visibility is significantly limited such as during heavy rain, fog, or in a Beaufort sea state greater than 2. Monitoring will not start until one hour after sunrise and will cease one hour before sunset.

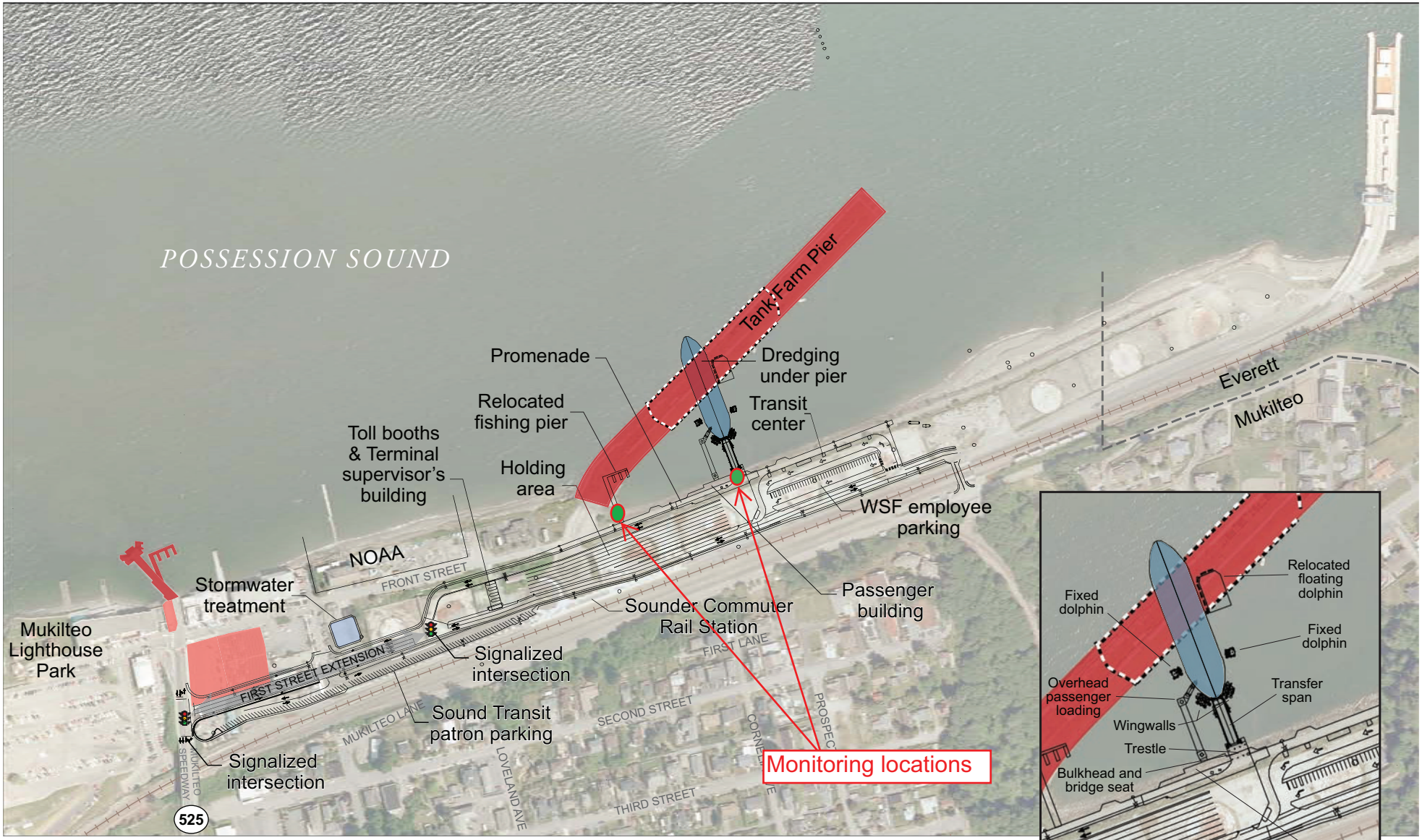


Figure 1. Marbled murrelet monitoring locations

Table 1 – Beaufort Wind Scale develop in 1805 by Sir Francis Beaufort of England (0=calm to 12=hurricane)

Force	Wind (knots)	Classification	Appearance of wind effects on the water	Appearance of wind effects on land	Notes specific to on-water seabird observations
0	<1	Calm	Sea surface smooth and mirror like	Calm, smoke rises vertically	Excellent conditions, no wind, small or very smooth swell. You have the impression you could see anything.
1	1-3	Light air	Scaly ripples, no foam crests	Smoke drift indicates wind direction, still wind vanes	Very good conditions, surface could be glassy (Beaufort 0), but with some lumpy swell or reflection from forests, glare, etc.
2	4-6	Light breeze	Small wavelets, crests glassy, no breaking	Wind felt on face, leaves rustle, vanes begin to move	Good conditions, no whitecaps, texture/lighting contrast of water make murrelets hard to see. Surface could also be glassy or have small ripples, but with a short, lumpy swell, thick fog, etc.
3	7-10	Gentle breeze	Large wavelets, crests beginning to break, scattered whitecaps	Leaves and small twigs constantly moving, light flags extended	Surveys cease, , scattered whitecaps present, detection of murrelets definitely compromised, a hit-or-miss chance of seeing them owing to water choppiness and high contrast. This could also occur at lesser wind with a very short wavelength, choppy swell.
4	11-16	Moderate breeze	Small waves 0.3 to 1.1m becoming longer, numerous whitecaps	Dust, leaves, and loose paper lifted, small tree branches move	Poor conditions, end surveys, whitecaps abundant, sea chop bouncing the boat around, etc.
5	17-21	Fresh breeze	Moderate waves 1.1 to 2.0 m taking longer form, many whitecaps, some spray	Small trees begin to sway	

3.6 Documentation

The biologists will document the number and general location of all murrelets. Additional information on other seabirds and behaviors will be collected during documentation to improve general data knowledge on seabird presence and distribution as well as project impacts on various seabirds. Each observer will record information using the Seabird Monitoring Data Collection Form and reference completed Seabird Monitoring Site/Transects Identification and Seabird Land-Based Monitoring Site Forms. Forms are included in the Appendix.

Data Collection

All murrelets within transects or monitoring sites will be continuously documented during impacting activities. On the Seabird Monitoring Data Collection Form, document the time, number of birds, location, and observed behavior (See Example Dolphin Repair). Update the documentation when a murrelet changes behavior, changes location, or leaves the area. To the extent possible, the observers will also record each murrelet "take" incident observed, as defined in the final Biological Opinion. This may include obvious disturbance responses from pile driving or other construction activities, and injury or mortality that can be attributed to project-related activities.

Observers will also note all seabirds within the area that appear to be acting abnormally during any project activities. For example, if a seabird is listing, paddling in circles, shaking head, or suddenly flushing at the onset of activity, note the information on the Seabird Monitoring Data Collection Form. For all birds except murrelets, providing a genus level (grebe, loon, cormorant, scoter, gull, etc) of identification is sufficient.

General information on other seabird behavior and distribution within the monitoring area will be collected. Every two hours at minimum during pile driving activities, the observer will document other seabird presence, behavior, and distribution in the monitoring area. This information can be collected more frequently. Many seabirds may linger in an area for several hours. If this is the case, note the time, species, and in the comments section identify that this is the same group from earlier and document any notable changes in behavior.

Under location, the data form indicates two separate options for documenting location. Land-based observers can fill out the land-based only or both land-based and boat sections. The land-based location will be based on the grid drawn out on the *Seabird Land-Based Monitoring Site Form* (See Example Dolphin Repair). For the boat transect locations, identify the distance in meters from the boat to the seabird and whether it is landward (toward activity) or seaward (away from activity).

3.7 Timing and Duration

Monitoring will commence at least 30 minutes before the initiation of pile driving (but not before daylight) and will continue until pile driving is completed each day (but not after nightfall). The monitoring set-up (i.e., number and location of observers) should allow for the entire monitoring are to be covered within five minutes.

3.8 Contingency

In the unlikely event that a murrelet is perceived to be injured by pile driving, all pile driving will cease and WFWO will be contacted as soon as possible.

The WSF will work with WFWO to make necessary changes to the monitoring plan as described in section 2.0 above. Pile driving cannot resume until the plan has been amended, unless the WFWO cannot be reached, then the Lead Biologist determines the course of action and continues to ensure consistency with the consultation.

4.0 Beach Surveys

Searches for diving seabird carcasses along nearby beaches will be conducted following pile driving activities. The biologist will walk accessible beaches within 0.5 mile of the pile driving location. Beach surveys will be conducted during low or receding tides, if possible, to maximize the chances of finding beached carcasses. Beach surveys will be conducted each day following in-water impact pile driving (as is practical based on the timing of tide events and pile driving activities.) Beach surveys are of secondary priority and will not be conducted if such activities would interfere with the implementation of murrelet monitoring or if the timing of low/receding tides imposes unreasonable schedule demands on the biologist.

Any dead murrelets or other diving seabirds found during the beach surveys (or during monitoring activities) will be collected by monitoring staff and delivered, as soon as possible, to the WFWO in Lacey, Washington for examination. Collected carcasses will be put in plastic bags, and kept cool (but not frozen) until delivery to the WFWO. Surveyors will follow the chain-of-custody process included in the consultation documents.

5.0 FWS Communication

Prior to the initiation of monitoring the WSF and a representative from the WFWO will meet to review the proposed monitoring location and logistics concerns that may have developed during monitoring preparation. The WSF will keep the WFWO informed of the progress and effectiveness of the monitoring activities and of the number and disposition of murrelet take that is documented throughout the duration of the project.

The WSF will notify the WFWO of any problems and/or necessary modification to the monitoring protocol. The WSF will coordinate with the WFWO in the development of a modified approach and will seek WFWO approval for such modifications.

Primary points of contact at the WFWO are:
1. Ryan McReynolds – phone (360) 753-6047
2. Emily Teachout – phone: (360) 753-9583
3. Deanna Lynch – phone: (360) 753-9545

Primary points of contact at the WSF are:
1. Rick Huey – phone: (206) 515-3721 or (206)-330-5149 (cell)
2. Burt Miller – phone: (206) 515-3756
3. Kojo Fordjour– phone: (206) 515-3650

6.0 Personnel Qualifications and Training

All observers must be certified under the Marbled Murrelet Marine Protocol. Observers will have appropriate qualifications, including education or work experience in biology, ornithology, or a closely related field; at least one season (2-3 months) of work with bird identification being the primary objective (i.e. not incidental to other work). Observers must have experience identifying marine birds in the Pacific Northwest, as well as understanding and documenting bird behavior.

All observers will attend the marbled murrelet marine monitoring protocol training and pass the written and photo examination with 90% proficiency. Upon successful completion, observers will be certified. Certification is valid for one year.

Recertification is required annually, unless the observer can document that he/she implemented the monitoring protocol for at least 25 monitoring days in the previous year. Recertification can then be delayed for one year; however, recertification can only be delayed for one year.

Certifications will be considered expired after one year, unless the WFWO is notified by the biologist that greater than 25 days of survey were done within one year of their certificate date. If an observer does conduct greater than 25 days of survey the certificate will be valid for an additional year from the certificate date. To extend a certification the biologist sends an email to the attention of Emily Teachout (emily_teachout@fws.gov) with the dates of the surveys they conducted and the date of their original certificate. The WFWO will maintain a list a certified observers and it will be available on our website.

The WSF is expected to provide all observers with a copy of the consultation documents for the project. Observers must read and understand the contents of the consultation documents related to identifying, minimizing, and reporting "incidental take" of murrelets.

7.0 Reporting

At the completion of each in-water work window for which there has been impact pile driving, the WSF will forward a monitoring report to the WFWO within 30 days. Reports shall be sent to the attention of (WFWO Branch Manager). The report shall include:

- Observation dates, times, and conditions
- Description of the any "take" (as described in the final Biological Opinion) identified by the biologist
- Copies of field data sheets or logs

Note: Questions and comments regarding this protocol should be directed to Emily Teachout at the USFWS, Washington Fish and Wildlife Office (360-753-9583); emily_teachout@fws.gov

APPENDIX

Print Form

Seabird Monitoring Site/Transect Identification Form

Project Name

Monitoring Dates

Number of Monitoring Sites/Transects

Insert aerial photo of entire monitoring project area. Identify each monitoring site/transect. Each monitoring station will reflect the 50 meter zone for each observer. For example, if there are two observers on a boat transect, the box will be 100 meters wide. Some monitoring stations will overlap and should be indicated here.

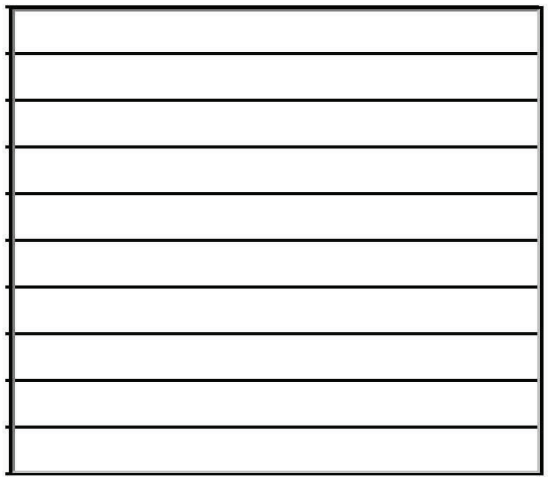
Seabird Land-Based Monitoring Site Form

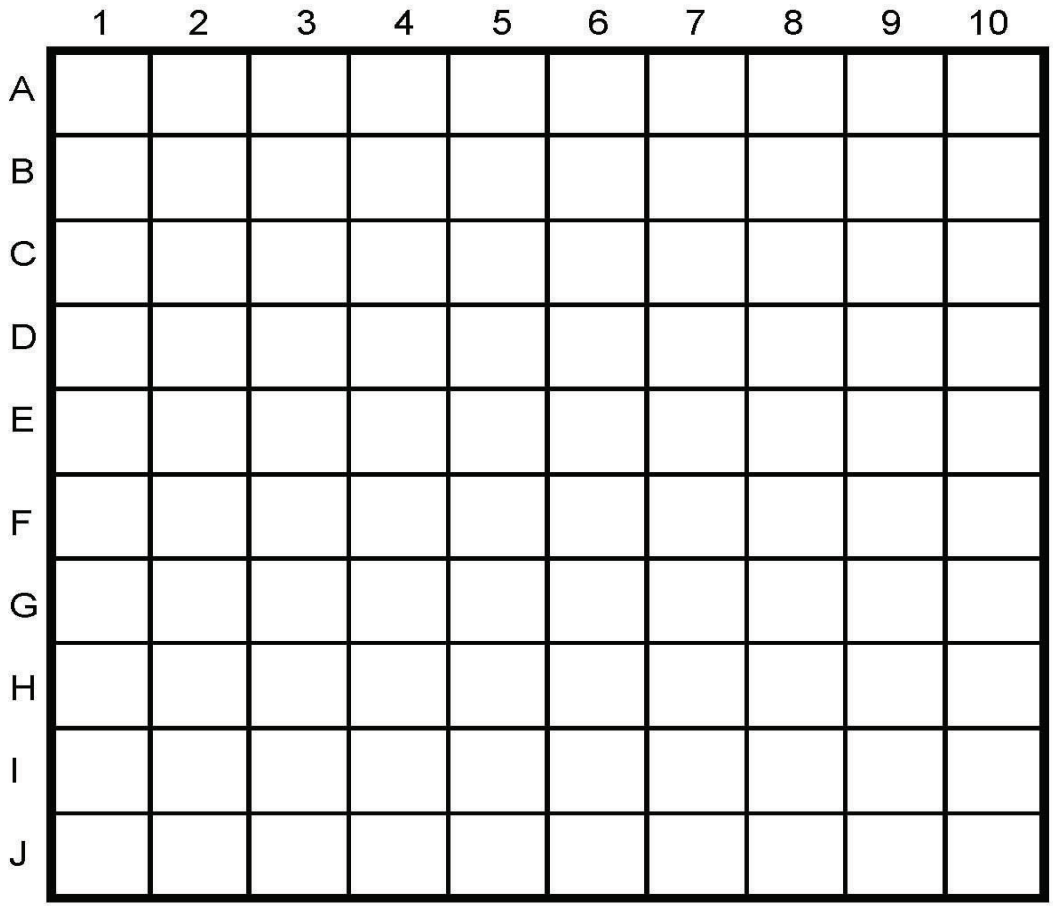
Project Name _____ **Date** _____

Land Based Monitoring Site ID _____

For each monitoring station referenced in the main map grid, sketch the coastline using the 5 meter squares. Indicate the direction to where impacting activities are occurring.

Use space below to describe additional monitoring site details that may be pertinent such as other structures seabirds may use.





Seabird Monitoring Data Collection Form

Date_____

Project Name _____ **Monitoring Site/Transect ID** _____

Observers_____

Activity _____ **Time and Duration**_____

Time	Species	# of birds	Wind speed (Beaufort Marine scale)	Land Observer	Boat Observer		Observed Behavior*	Comments
				Grid Location	Distance	Land/Sea Ward		

* R=resting, F=feeding/diving, P=preening, Y=flying/flushing, T=transient, N=nesting, O=other

Appendix C. Underwater Noise Monitoring Plan

Mukilteo Multimodal Project
Overhead Loading and Terminal Improvement Project
UNDERWATER NOISE MONITORING PLAN

Prepared by:
Washington State Department of Transportation
Office of Air Quality and Noise
15700 Dayton Avenue North, P.O. Box 330310
Seattle, WA 98133-9710

July 3, 2012

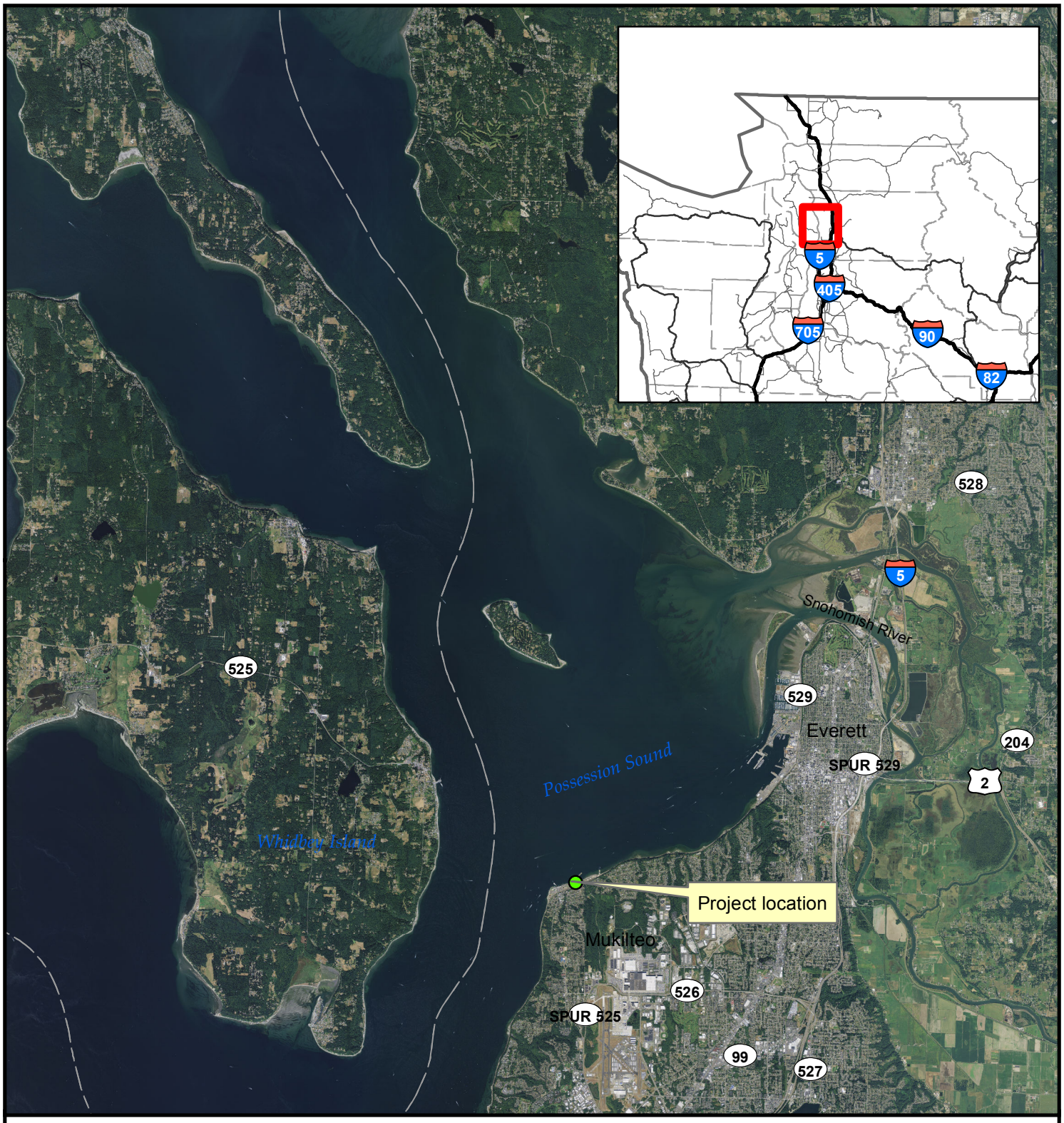


Figure 1. Mukilteo Multimodal Project vicinity map

0 0.5 1 2 Miles

N

Washington State Department of Transportation

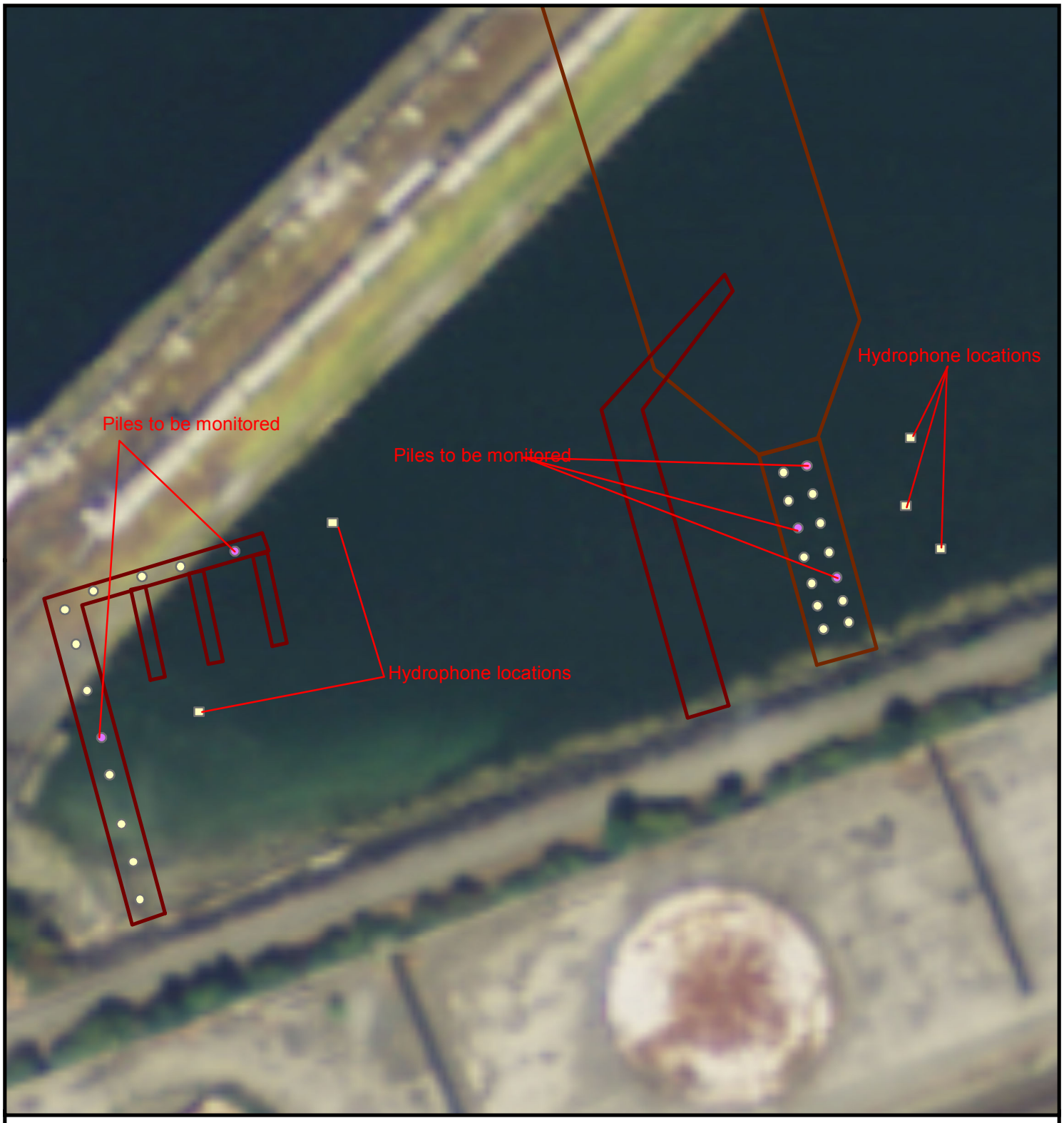


Figure 2. Location of the new trestle and fishing pier, piles that will be monitored, and hydrophone locations.

0 25 50 100 Feet

N

Washington State Department of Transportation

Table 1 lists the bridge seat and HPU platform to be installed, the water depth, and the number and size of piles that will be installed.

Table 1
Depth, Number Piles to be Monitored

Structure	Water Depth	Structural Components Installed
Ferry trestle	*-10 feet to -30 feet*	*14 24-inch concrete piles*
Fishing pier	*-10 feet to -30 feet*	*12 24-inch concrete piles*

METHODOLOGY

Background underwater noise levels will be measured for a minimum of three full 24-hour cycles (i.e., 6 am to 6 am) in the absence of construction activities to determine background sound levels for frequencies between 20 Hz and 20 kHz. Following NMFS guidance (NMFS 2009), analysis will be conducted using data from the full range of frequencies recorded for fish and murrelets and using a high pass filter at 150 Hz and 75 Hz, thus corresponding to the marine mammal functional hearing groups outlined by Southall (2007). Data will be used to calculate 30-second Root Mean Square (RMS) values for each 30 seconds of the three 24-hour cycles measured. These data will be used to calculate and plot a Cumulative Distribution Function (CDF) (NMFS 2009). Overall average background sound levels will be reported as the 50% CDF and include a spectral analysis of the frequencies (NMFS 2009) for a minimum of an hourly cycle.

All piles monitored will be tested with a sound attenuation system on only. No unattenuated pile strikes will be attempted for this project, per USFWS requirements (Hamilton, pers. comm.)[1]. Hydrophones, signal amplifiers, and calibrators will be used to monitor underwater noise (Table 2). Monitoring equipment will be set to 20 Hz to 20 kHz with a sampling rate of 48 kHz. To facilitate further analysis of data the underwater signal will be recorded as a text file (.txt) or wave file (.wav).

[1] Hamilton, Brooke. USFW. 2009 Personal communication. Email to Rick Huey, WSF. December 7, 2009. Note: There may be circumstances where the U.S. Fish and Wildlife Service determines that unattenuated pile driving (striking the pile with the bubble curtain turned off) would pose a significant risk of injury to marbled murrelets. In those situations, the Service may request that unattenuated pile driving does not occur and that hydroacoustic monitoring be conducted to determine the extent at which certain thresholds are met instead. This will need to be determined on a case by case basis for projects that may affect marbled murrelets.

Table 2.
Equipment for underwater sound monitoring (hydrophone, signal amplifier, and calibrator). All have current National Institute of Standards and Technology (NIST) traceable calibration.

Item	Specifications	Quantity	Usage
Hydrophone with 200 feet of cable	*Receiving Sensitivity- 211dB ±3dB re 1V/µPa*	*1*	*Capture underwater sound pressures and convert to voltages that can be recorded/analyzed by other equipment.*
Signal Conditioning Amplifier (4-channel)	*Amplifier Gain- 0.1 mV/pC to 10 V/pC Transducer Sensitivity Range- 10-12 to 103 C/MU*	*1*	*Adjust signals from hydrophone to levels compatible with recording equipment.*
Calibrator (pistonphone-type)	*Accuracy- IEC 942 (1988) Class 1*	*1*	*Calibration check of hydrophone in the field.*
Portable Dynamic Signal Analyzer (4-channel)	*Sampling Rate- 24K Hz or greater*	*1*	*Analyzes and transfers digital data to laptop hard drive.*
Microphone (free field type)	*Range- 30 – 120 dBA Sensitivity- -29 dB ± 3 dB (0 dB = 1 V/Pa)*	*1*	*Monitoring airborne sounds from pile driving activities (if not raining).*
If velocity ~> 1m/s, Flow shield	*Open cell foam cover or functional equivalent*	*1/hydrophone*	*Eliminate flow noise contamination.*
Laptop computer	*Compatible with digital analyzer*	*1*	*Record digital data on hard drive and signal analysis.*
Real Time and Post-analysis software	-	*1*	*Monitor real-time signal and post-analysis of sound signals.*

The hydrophone(s) will be placed at between 0.7H and 0.85H, where H is the water depth, at distance of 10 meters from each pile being monitored. A weighted tape measure will be used to determine the depth of the water. The hydrophone(s) will be attached to a nylon cord or a steel chain if the current is swift enough to cause strumming of the line. The nylon cord or chain will be attached to an anchor that will keep the line the appropriate distance from each pile. The nylon cord or chain will be attached to a float or tied to a static line at the surface. The distances will be measured by a tape measure, where possible, or a range-finder. There should be a direct line of sight between the pile and the hydrophone(s) in all cases.

For background measurements when the water velocity is greater than 1 meter/second, a flow shield around each hydrophone will be used to provide a barrier between the irregular, turbulent flow and the hydrophone. Velocity will be measured concurrent to sound measurements. If velocity is greater than 1 meter/second, a correlation between sound levels and current speed will be made to determine whether the data is valid and should be included in the analysis. The hydrophone calibration(s) will be checked at the beginning of each day of monitoring activity. Prior to the initiation of pile driving, the hydrophone will be placed at the appropriate distance and depth as described above.

The inspector/contractor will inform the acoustics specialist when pile driving is about to start to ensure that the monitoring equipment is operational. Underwater sound levels will be continuously monitored during the entire duration of each pile being driven. Peak levels of each strike will be monitored in real time. Sound pressure will be measured in Pascals which are easily converted to decibel (dB) units (e.g. 1000 Pascals = 180 dB).

Prior to, and during, the pile driving activity, environmental data will be gathered, such as wind speed and direction, air temperature, humidity, surface water temperature, water depth, wave height, weather conditions, and other factors that could contribute to influencing the underwater sound levels (e.g. aircraft, boats, etc.). Start and stop time of each pile driving event and the time at which the bubble curtain or functional equivalent is turned on and off will be recorded.

The chief inspector will supply the acoustics specialist with a description of the substrate composition, approximate depth of significant substrate layers, hammer model and size, hammer energy settings and any changes to those settings during the piles being monitored, depth pile driven, blows per foot for the piles monitored, and total number of strikes to drive each pile that is monitored.

SIGNAL PROCESSING

Post-analysis of the sound level signals will include determination of the maximum absolute value of the instantaneous pressure within each strike, Root Mean Square (RMS) value for each absolute peak pile strike of each pile, rise time, number of strikes per pile and per day, number of strikes exceeding 206 dB_{peak}, number or percent of individual strikes exceeding 183 dB Cumulative Sound Exposure Level (SEL_{cum}), SEL of the pile strike with the absolute peak sound pressure, mean SEL, and cumulative SEL (cumulative SEL = single strike SEL + 10*log (# hammer strikes)) and a frequency spectrum, between a minimum of 20 and 20,000 Hz for up to eight successive strikes with similar sound levels. Calculation methodology is provided in Appendix A. When possible the single strike SEL for each hammer strike will be estimated and then these values will be accumulated for the cumulative SEL value (See Appendix A).

Background sound levels were analyzed by calculating 30-second RMS values and plotting these values on a CDF. The average background sound levels were estimated using the 50% CDF (See Appendix B).

ANALYSIS

Analysis of the data from the San Francisco-Oakland Bay Bridge Pile Driving Demonstration project (PIDP) indicated that 90 percent of the acoustic energy for most pile driving impulses occurred over a 50 to 100 milliseconds period with most of the energy concentrated in the first 30 to 50 milliseconds (Illingworth and Rodkin, 2001). The RMS values computed for this project will be computed over the duration between where 5% and 95% of the energy of the pulse occurs. The SEL energy plot will assist in interpretation of the single strike waveform. The single strike SEL associated with the highest absolute peak strike along with the total number of strikes per pile and per day will be used to calculate the cumulative SEL for each pile and each 24-hour period

In addition a waveform analysis of the individual absolute peak pile strikes will be performed to determine any changes to the waveform with the bubble curtain. Units of underwater sound pressure levels will be dB re: 1 micropascal and units of SEL will be re: 1 micropascal^{2}sec.

REPORTING

A draft report including data collected and summarized from all monitoring locations will be submitted to the Services within 60 days of the completion of hydroacoustic monitoring. The results will be summarized in graphical form and include summary statistics and time histories of impact sound values for each pile. A final report will be prepared and submitted to the Services within 30 days following receipt of comments on the draft report from the Services. The report shall include:

1. Size and type of piles.
2. A detailed description of the bubble curtain, including design specifications.
3. The impact hammer energy rating used to drive the piles, make and model of the hammer.
4. A description of the sound monitoring equipment.
5. The distance between hydrophone(s) and pile.
6. The depth of the hydrophone(s) and depth of water at hydrophone locations.
7. The distance from the pile to the waters edge.
8. The depth of water in which the pile was driven.
9. The depth into the substrate that the pile was driven.
10. The physical characteristics of the bottom substrate into which the piles were driven.
11. The total number of strikes to drive each pile and for all piles driven during a 24-hour period.

12. The background sound pressure level reported as the 50% CDF.
13. The results of the hydroacoustic monitoring, including the frequency spectrum, ranges and means including standard deviation/error for peak SPL's, single-strike and cumulative SEL with the attenuation system on only, an estimation of the number of strikes that exceeded the cumulative SEL threshold and an estimation of the distance at which the peak and cumulative SEL values reach the respective thresholds and the distance at which the RMS values reach the relevant marine mammal thresholds and background sound levels. If vibratory installation is monitored, vibratory monitoring results will include the maximum and overall average RMS calculated from 10-second RMS values during the drive of the pile.
14. A description of any observable fish, marine mammal or bird behavior in the immediate area will and, if possible, correlation to underwater sound levels occurring at that time.

REFERENCES

Illingworth and Rodkin, Inc. 2001. Noise and Vibration Measurements Associated with the Pile Installation Demonstration Project for the San Francisco-Oakland Bay Bridge East Span, Final Data Report, and Task Order 2, Contract No. 43A0063.

NMFS, 2009. Guidance Document: Data Collection Methods to Characterize Background and Ambient Sound within Inland Waters of Washington State. Memorandum: NMFS Northwest Fisheries Science Center – Conservation Biology Division and Northwest Regional Office – Protected Resources Division, November 30, 2009.

Southall, Brandon L., Ann E Bowles, William T. Ellison, James J. Finneran, Roger L. Gentry, Charles R. Greene Jr., David Kastak, Darlene R. Ketten, James H. Miller, Paul E. Nachtigall, W. John Richardson, Jeanette A. Thomas, and Peter L. Tyack. 2007. Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations. Aquatic Mammals, Volume 33, Number 4.

APPENDIX A

Calculation of Cumulative SEL

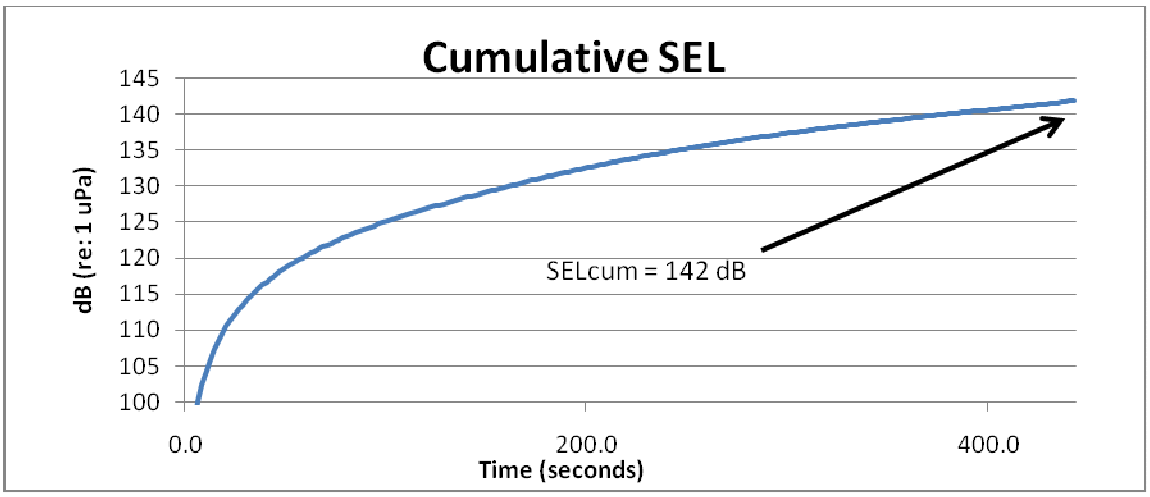
An estimation of individual SEL values can be calculated for each pile strike by calculating a 1-second Leq for each individual pile strike. As can be seen in equation 1 below the SEL is essentially a subset of the LEQ function. When the time interval for the Leq is set to one second it is equal to the SEL. The accumulated SEL values produced by calculating a 1 second Leq for each pile strike can then be accumulated for each pile strike.

Calculating a cumulative SEL from individual SEL values cannot be accomplished simply by adding each SEL decibel level arithmetically. Because these values are logarithms they must be added logarithmically. Perhaps the easiest method for adding decibels logarithmically

$$L_{eq,T} = 10\lg\left(\frac{1}{T}\int_0^T \frac{p^2(t)}{p_0^{\,2}}dt\right)\ dB \quad = \quad SEL = 10\lg\left(\int_{-\infty}^{\infty} \frac{p^2(t)}{p_0^{\,2}}dt\right)\ dB \qquad \text{(eq. 1)}$$

Calculating a cumulative SEL from individual SEL values cannot be accomplished simply by adding each SEL decibel level arithmetically. Because these values are logarithms they must first be converted to antilogs and then accumulated. Perhaps the easiest method for this is to divide each SEL decibel level by 10 and then take the antilog. This will convert the decibels to units of MicroPascals. Paste these values into a spreadsheet and then sort from smallest to largest value. In a separate column starting with the second row of these values add this value to the one above it and then repeat this process to the last row of data. The last value in this column is the cumulative SEL in units of MicroPascals. Next convert the microPascal values to dBSEL by dividing each value by the total number of values and calculating the log base 10 of each of these values, then multiply by 20 to get dBSEL.

It is recommended that you also plot these values on a cumulative plot such as the one below.

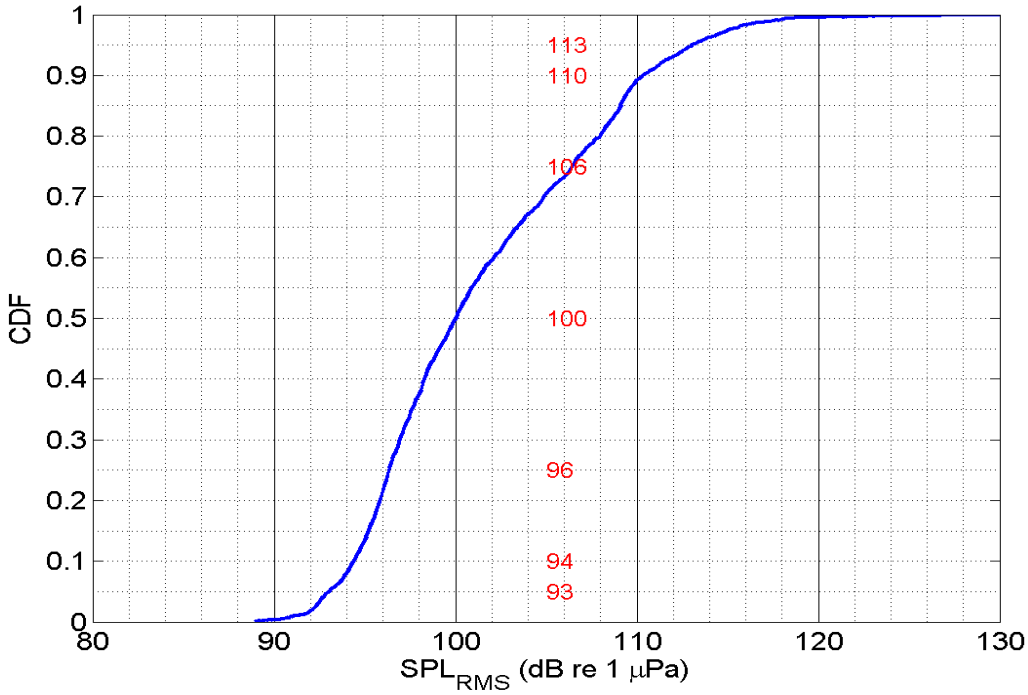


APPENDIX B

Calculation of a Cumulative Distribution Function and Plot for Background Sound Level Analysis

Data from three full 24-hour cycles (minimum) are used to calculate a 30-second Root Mean Square (RMS) value for each 30-second period for the entire dataset. The RMS should be calculated for the full frequency range recorded for fish and murrelets, as well as separate datasets which have been passed through a high pass filter thus eliminating those frequencies below 1000 Hz, 150 Hz and 75 Hz individually which correspond to the functional hearing groups for marine mammals in Southall (2007). These datasets are then grouped into 24-hour periods. To determine if the data is approximately log-normal in distribution, each 24-hour period is plotted as a Probability Density Function (PDF). Each 24-hour period can be plotted on the same PDF plot. The plots should be approximately log normal in distribution and thus can be used in the further analysis. Each day of data should have an approximately Gaussian sigmoid shape, the differences between them and the ideal might be hard to spot, but the sigmoid from day to day will show noticeable variation. Data which does not approximate a log normal distribution should be excluded from further analysis.

The Cumulative Distribution Function (CDF) plot is obtained by plotting the normalized cumulative sum vs. the bin location. You can also get the PDF from plotting the normalized bin count vs. the bin location. The normalized bin count is obtained by dividing the count column by (number of data points multiplied by the space between 2 consecutive bins). This provides the integral of the PDF equal to 1. See:
http://www.vertex42.com/ExcelArticles/mc/Histogram.html


CDF
SPL$_{RMS}$ (dB re 1 μPa)
113
110
106
100
96
94
93

Appendix D. Stormwater Modeling Inputs and Results

Highway Runoff Dilution and Loading model (HI-RUN) Version 2.0

End of Pipe Loading Subroutine Report

This model is for stormwater analysis associated with biological assessments, and is not a design tool.

Input Summary

Run Date/Time: 8/22/12 08:55
Outfall ID: test
Rain Gauge: Puget East 36
Description:

Discharge Areas

Subbasin 1 - Baseline Conditions - 1.89 acres
no treatment - 0% infiltration - 1.89 acres

Subbasin 1 - Proposed Conditions - 3 acres
enhanced treatment - 0% infiltration - 3 acres

Load Analysis TDA 4-24

	TSS Load (lb/yr)		Total Copper Load (lb/yr)		Dissolved Copper Load (lb/yr)		Total Zinc Load (lb/yr)		Dissolved Zinc Load (lb/yr)	
	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed
Max	59132	25693	7.79	1.2	2.61	0.99	41	7.1	32.4	7.5
75th Perce	1540	253	0.339	0.14	0.079	0.091	2.08	0.7	0.632	0.48
Median	751	110	0.192	0.095	0.044	0.059	1.16	0.45	0.33	0.3
25th Perce	366	48	0.108	0.064	0.025	0.038	0.654	0.29	0.174	0.19
Min	9.7	0.53	0.005	0.006	0.001	0.003	0.024	0.029	0.006	0.014
P (exceed)		0.119		0.25		0.603		0.189		0.468

Concentration Analysis

Subbasi	TSS Conc (mg/L)		Total Copper Conc (mg/L)		Dissolved Copper Conc (mg/L)		Total Zinc Conc (mg/L)		Dissolved Zinc Conc (mg/L)	
	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed
Max	4464.03	951.305	0.572	0.048	0.212	0.039	3.146	0.486	1.827	0.257
75th Perce	123.846	12.83	0.027	0.007	0.006	0.005	0.167	0.035	0.052	0.024
Median	61.351	5.678	0.016	0.005	0.004	0.003	0.095	0.023	0.027	0.016
25th Perce	30.427	2.496	0.009	0.003	0.002	0.002	0.054	0.015	0.014	0.01
Min	0.699	0.02	0	0	0	0	0.003	0.001	0	0.001
P (exceed)		0.068		0.121		0.429		0.087		0.312

Highway Runoff Dilution and Loading model (HI-RUN) Version 2.0

End of Pipe Loading Subroutine Report

This model is for stormwater analysis associated with biological assessments, and is not a design tool.

Input Summary

Run Date/Time: 8/22/12 08:58
Outfall ID: test
Rain Gauge: Puget East 36
Description:

Discharge Areas

Subbasin 2 - Baseline Conditions - 0.54 acres
no treatment - 0% infiltration - 0.54 acres

Subbasin 2 - Proposed Conditions - 4.57 acres
enhanced treatment - 0% infiltration - 4.57 acres

Load Analysis **TDA 5-30**

	TSS Load (lb/yr)		Total Copper Load (lb/yr)		Dissolved Copper Load (lb/yr)		Total Zinc Load (lb/yr)		Dissolved Zinc Load (lb/yr)	
	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed
Max	16895	39138	2.22	1.8	0.745	1.5	11.7	11	9.26	11
75th Perce	440	385	0.097	0.22	0.022	0.14	0.594	1.1	0.181	0.73
Median	215	168	0.055	0.15	0.013	0.089	0.333	0.69	0.094	0.46
25th Perce	105	73	0.031	0.097	0.007	0.058	0.187	0.44	0.05	0.29
Min	2.77	0.8	0.002	0.009	0	0.004	0.007	0.044	0.002	0.021
P (exceed)		0.441		0.826		0.967		0.751		0.912

Concentration Analysis

Subbasi	TSS Conc (mg/L)		Total Copper Conc (mg/L)		Dissolved Copper Conc (mg/L)		Total Zinc Conc (mg/L)		Dissolved Zinc Conc (mg/L)	
	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed
Max	4464.03	951.305	0.572	0.048	0.212	0.039	3.146	0.486	1.827	0.257
75th Perce	123.846	12.83	0.027	0.007	0.006	0.005	0.167	0.035	0.052	0.024
Median	61.351	5.678	0.016	0.005	0.004	0.003	0.095	0.023	0.027	0.016
25th Perce	30.427	2.496	0.009	0.003	0.002	0.002	0.054	0.015	0.014	0.01
Min	0.699	0.02	0	0	0	0	0.003	0.001	0	0.001
P (exceed)		0.068		0.121		0.429		0.087		0.312

Highway Runoff Dilution and Loading model (HI-RUN) Version 2.0

End of Pipe Loading Subroutine Report

This model is for stormwater analysis associated with biological assessments, and is not a design tool.

Input Summary

Run Date/Time: 8/22/12 09:00
Outfall ID: test
Rain Gauge: Puget East 36
Description:

Discharge Areas

Subbasin 3 - Baseline Conditions - 0.01 acres
no treatment - 0% infiltration - 0.01 acres

Subbasin 3 - Proposed Conditions - 2.63 acres
enhanced treatment - 0% infiltration - 2.63 acres

Load Analysis **TDA 6-XX**

	TSS Load (lb/yr)		Total Copper Load (lb/yr)		Dissolved Copper Load (lb/yr)		Total Zinc Load (lb/yr)		Dissolved Zinc Load (lb/yr)	
	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed
Max	313	22524	0.041	1	0.014	0.87	0.217	6.2	0.171	6.5
75th Percentile	8.15	222	0.002	0.12	0	0.079	0.011	0.62	0.003	0.42
Median	3.98	97	0.001	0.084	0	0.051	0.006	0.4	0.002	0.27
25th Percentile	1.94	42	0.001	0.056	0	0.033	0.003	0.26	0.001	0.17
Min	0.051	0.46	0	0.005	0	0.002	0	0.025	0	0.012
P (exceed)		0.976		1		1		1		1

Concentration Analysis

Subbasin 3	TSS Conc (mg/L)		Total Copper Conc (mg/L)		Dissolved Copper Conc (mg/L)		Total Zinc Conc (mg/L)		Dissolved Zinc Conc (mg/L)	
	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed
Max	4464.03	951.305	0.572	0.048	0.212	0.039	3.146	0.486	1.827	0.257
75th Percentile	123.846	12.83	0.027	0.007	0.006	0.005	0.167	0.035	0.052	0.024
Median	61.351	5.678	0.016	0.005	0.004	0.003	0.095	0.023	0.027	0.016
25th Percentile	30.427	2.496	0.009	0.003	0.002	0.002	0.054	0.015	0.014	0.01
Min	0.699	0.02	0	0	0	0	0.003	0.001	0	0.001
P (exceed)		0.068		0.121		0.429		0.087		0.312

Table 1. Input Parameters for CORMIX Modeling (provided by WSF, BergerABAM, and compiled by CHE based on previous studies)

Input Parameter	Notation	Unit	24"MHHW_DCU	24"MHHW_DZn	30"MHHW_DCU	30"MHHW_DZn	18"MHHW_DCU	18"MHHW_DZn
Ambient parameters								
Cross-section			unbounded	unbounded	unbounded	unbounded	unbounded	unbounded
Avergae depth	HA	m	3.54	3.54	7.02	7.02	4.3	4.3
Depth at discharge	HD	m	2.72	2.72	5.4	5.4	4	4
Ambient velocity	UA	m/s	0.15	0.15	0.15	0.15	0.15	0.15
Manning's n		-	0.02	0.02	0.02	0.02	0.02	0.02
Wind velocity	UW	m/s	5.14	5.14	5.14	5.14	5.14	5.14
Stratification type	STRCND	-	U	U	U	U	U	U
Surface density	RHOAS	kg/m^3	1025	1025	1025	1025	1025	1025
Bottom density	RHOAB	kg/m^3	1025	1025	1025	1025	1025	1025
Discharge parameters (single port)					submerged			
Nearest bank			right	right	right	right	right	right
Distance to bank	DISTB	m	57.1	57.1	8	8	5.6	5.6
Port diameter	D0	m	0.6096	0.6096	0.762	0.762	0.4572	0.4572
Port cross-sectional area	A0	m^2	0.2919	0.2919	0.456	0.456	0.164	0.164
Discharge velocity	U0	m/s	1.2	1.2	1.4	1.4	0.4	0.4
Discharge flowrate	Q0	m^3/s	0.351129	0.351129	0.637129	0.637129	0.065	0.065
Discharge port height	H0	m	0.91	0.91	3.61	3.61	2.9	2.9
Vertical discharge angle	THETA	deg	0	0	0	0	0	0
Horizontal discharge angle	SIGMA	deg	90	90	90	90	90	90
Discharge density	RHO0	kg/m^3	1000	1000	1000	1000	1000	1000
Density difference	DRHO	kg/m^3	25	25	25	25	25	25
Buoyant acceleration	GP0	m/s^2	0.2392	0.2392	0.2392	0.2392	0.2392	0.2392
Discharge concentration	C0	mg/l	0.004	0.025	0.004	0.026	0.004	0.026
surface heat exchange coeff.	KS	m/s	0	0	0	0	0	0
Coefficient of decay	KD	/s	0	0	0	0	0	0
Mixing Zone								
Toxic discharge			no	no	no	no	no	no
Water quality standard specified			yes	yes	yes	yes	yes	yes
Water quality standard	CSTD	mg/l	0.002	0.0056	0.002	0.0056	0.002	0.0056
Regulatory mixing zone			no	no	no	no	no	no
Region of interest		m	1000	1000	1000	1000	1000	1000

The mixing zone sizes presented here correspond to Mean Higher High Water (MHHW) conditions that are found to be the critical (conservative) case. During lower tide elevations mixing zone size reduces.

Table 2. CORMIX Modeling Results, Mixing Zone Size 1

Outfall	Pollutant of Concern	Mixing Zone Size (m/ft)	
		Pre-Project	Post-Project
#4-24 (24")	Dissolved copper	3.92/12.9	3.92/12.9
	Dissolved zinc	6.09/20.0	6.40/21.0
#5-30 (30")	Dissolved copper	5.81/19.1	5.81/19.1
	Dissolved zinc	13.30/43.6	14.08/46.2
New 18"	Dissolved copper	-	1.44/4.71
	Dissolved zinc	-	4.71/15.5

Appendix E. Noise Modeling Inputs and Results

Sound Exposure Level Calculator for Marbled Murrelet and Bull Trout

This spreadsheet was developed as an in-house tool for USFWS staff to use when assessing the effects to marbled murrelets (MAMU) and/or bull trout from impact pile driving. The USFWS makes this spreadsheet available to other users, and assumes no responsibility for errors when this tool is used by non-USFWS staff. Use this spreadsheet to calculate the distance to various thresholds for both MAMU and bull trout. The calculations incorporate the concept of effective quiet (EQ) wherein we assume that the energy from pile strikes below a certain SEL does not accumulate to cause injury.

Please contact the following USFWS to report errors or submit questions:

Emily Teachout, USFWS, Washington Fish and Wildlife Office, Lacey, WA, 360-753-9583, emily_teachout@fws.gov

Green cells = input. Input expected sound levels, distance, attenuation, and pile strikes
Blue cells = results. Results shown are based on the information in the green and yellow cells. DO NOT CHANGE
Yellow cells = threshold values and transmission loss constant. DO NOT CHANGE

	Peak	SEL	RMS	Single Strike SEL for Effective Quiet	Attenuation
Unattenuated single strike (dB)	184	159	170	150	0
Attenuated single strike(dB)	184	159	170		
Distance (m)	10	10	10		
Piles per day	5		Distance (m) to Bull Trout thresholds (SEL)		Distance (m) to MAMU thresholds (SEL)
Estimated strikes per pile	300		Fish ≤ 2g	Fish> 2g	Non-Injurious TS	Auditory Injury	Barotrauma	Distance to EQ
Estimated # strikes per day	1500		183	187	183	202	208	
Cum SEL at measured distance	190.8	>>----------->>>	33	18	33	2	1	40
Transmission loss constant	15				By adjusting the number of unattenuated strikes per pile, the desired/acceptable threshold distances can be reached.			
	Behavior				Cell E22, Distance to 183 dB for Total cumulative SEL does not consider Effective Quiet.			
	dBrms							
Potential Behavioral Response Zone	150							
Distance (m)	215							

Version 2/27/2012